



Strategic Mobility 21

Inland Port - Multi-Modal Terminal Operating System Design Specification

Contractor Report 0008

Prepared for:

Office of Naval Research
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In fulfillment of the requirements for:

FY 2005 Contract No. N00014-06-C-0060
Strategic Mobility 21 – CLIN 0008

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September 25, 2007

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September 25, 2007

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Subject: Deliverable Number 0008, Design Specification for Multi-modal Terminal
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Reference: Strategic Mobility 21 Contract N00014-06-C-0060

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In accordance with the requirements of referenced contract, we are pleased to submit
this Design Specification for Multi-modal Terminal Operating System Document for your
review.

Your comments on this document are welcomed.

Regards,

A handwritten signature in black ink, appearing to be "L. G. Mallon", written in a cursive style.

Dr. Lawrence G. Mallon
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cc: Administrative Contracting Officer (Transmittal Letter only)
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ABSTRACT

Strategic Mobility 21 (SM21) is a Congressionally mandated and independently funded applied research program through the Department of Defense (Office of Naval Research). The program is conducted under the auspices of the California State University – Long Beach Foundation, a government-industry academic collaborative enterprise. This design concept supports the SM21 efforts in developing a dual-use Inland Port - Multi-Modal Terminal Operating System (IP-MTOPS) located at the Southern California Logistics Airport in Victorville, California. In the context of the SM21 program, dual-use technology is defined as serving both the commercial and military sectors. The IP-MTOPS design concept will be employed to define the technical and functional requirements for procuring and integrating services required for a multi-modal node operating software system operating within a Service Oriented Architecture. The design concept is the basis for the development of a technical specification, which will be jointly developed with the Southern California Logistics Airport (SCLA) and the City of Victorville, California with input from the Department of Defense (DoD). The design concept supports the development of IP-MTOPS within the framework of a Service Oriented Architecture (SOA). The IP-MTOPS will be designed to enable efficient inland port operations by: optimizing logistics flows; supporting facility security requirements, helping to maintain desired daily facility and throughput productivity; and providing high service quality to strengthen customer relationships.

1.0 INTRODUCTION

This design concept supports the stepwise deployment of an Inland Port – Multi-Modal Terminal Operating System (IP-MTOPS)¹. IP-MTOPS is a software system concept designed to support the facilities and processes (functions) of a dual-use² multi-modal inland port currently under development by the Southern California Logistics Airport (SCLA) Authority, the City of Victorville, and Strategic Mobility 21 (SM21)³. IP-MTOPS will support the integration of the functional requirements independently developed by the SCLA Authority, the City of Victorville, and SM21. IP-MTOPS will support ten major functions typically required at a dual-use multi-modal distribution node. Since the SCLA is intended for dual-use, SM21 will coordinate with Department of Defense (DoD) stakeholders to integrate the functionality required to support the Joint Deployment and Distribution Enterprise (JDDE)⁴ with the required SCLA commercial functionality.

1.1 Service Oriented Architecture

It should be no surprise that a review of existing market offerings indicates that no single commercial software system, service, or vendor will meet all of the common and unique SCLA technical and functional requirements. Therefore, SM21 has determined that a SOA reference architecture will be employed as a framework for developing IP-MTOPS. In this document, SOA is a term used to describe an architecture in which automation logic is decomposed into smaller, distinct units of logic supporting individual business functions. Collectively, these units comprise a larger piece of business automation logic and ultimately provide the capability that will be required for IP-MTOPS to support SCLA. Individually, these units of logic, or software supported services, will be distributed and provided by the operating systems of the individual business operators, such as BNSF and Cal Cartage, which compose the SCLA. SM21, working with SCLA, will determine what required SCLA functions defined in this document are not provided by the distributed business services to support the collective business community. Based on the results of this joint SCLA-SM21 analysis, SM21 will search for existing software system services that are available from sources outside the SCLA to fill the gaps. When the appropriate existing services cannot be located, SM21 and SCLA will consider development of the required value-added services capable of closing the identified gaps. These additional value-added services will be made available through IP-MTOPS.

1.2 The SCLA Business Community

The business of the SCLA operators is the provisioning of logistic services (handling, management, transport, etc.) for freight transport. IP-MTOPS will support the cooperation among the SCLA operators, which can be referred to as the SCLA Cargo Community System. An abstraction for such an environment is what is often called the “Business Community” concept. A Business Community is a set of Business Operators (enterprises) that:

¹ The Inland Port Management Information System (IP-MTOPS) will be jointly developed at the former George Air Force Base, now the Southern California Logistics Airport (SCLA), to support SCLA and the Joint Deployment and Distribution Platform (JDDSP). The JDDSP is defined within the SM21 Initial Capability Document (ICD).

² Dual-use technology serves as a basis for both commercial and military sectors

³ SM21 will develop the military component of SCLA.

⁴ See footnote 2. The JDDE will be supported by the JDDSP, which is the military component of the SCLA.

- Share a common market sector (cargo freight transport into, through, and out of SCLA)
- Hold different roles on SCLA (like shippers, truck and rail transport operators, and 3rd party logistic service providers, etc.)
- Have already existing commercial relations
- Are coordinated by a Business Authority, who is generally an expert on the specific market (like the SCLA Authority)

The SCLA can take advantage of the existence of Business Community members with deployed network services. These services, integrated through the IP-MTOPS can improve the communications between Business Community Operators, exploiting common trading practices, and ruling the community and communications infrastructures enabling secure transactions. This target can be achieved if the Business Operators and the SCLA, as the Business Authority, participate with the following roles:

- The Business Authority (SCLA), supported by SM21, is in charge of maintaining the communication infrastructure that provides secure communication services, definitions and recommendations for application service implementations,
- Establishes, with support from SM21, commonly agreed document exchange format for transactions, and
- Capitalizing on SCLA and SM21 knowledge of the business and DoD sector

1.3 Functional, Technical, and Service Requirements Overview

This document provides an extensively researched list of the standard functional and technical requirements associated with an inland multi-modal port, which will enable analysts to identify capability gaps in existing military and commercial systems required to support SCLA. This document is ultimately designed to achieve the following objectives:

- Enable efficient SCLA operations in support of commercial and military shipments through the facility by *optimizing* logistics flows,
- Help maintain desired individual SCLA *productivity*
- Maintain high customer service *quality*,
- Strengthen customer relationships through up to the minute *visibility* of shipments and quick shipment processing times.

This document will be considered a living document until it is formally approved by a joint SCLA and SM21 Technical Committee. The document is organized into the following required functional or service areas: *General Requirements, Inventory Management, Shipping Order Management, Yard Operations, Highway Operations, Rail Operations, Airlift Operations, Warehouse Operations, Sealift Planning, Accounting, Notifications and Alerts, System Reports, Integration and Technical Requirements*. The functional areas requiring service support are visually depicted in Figure 1.

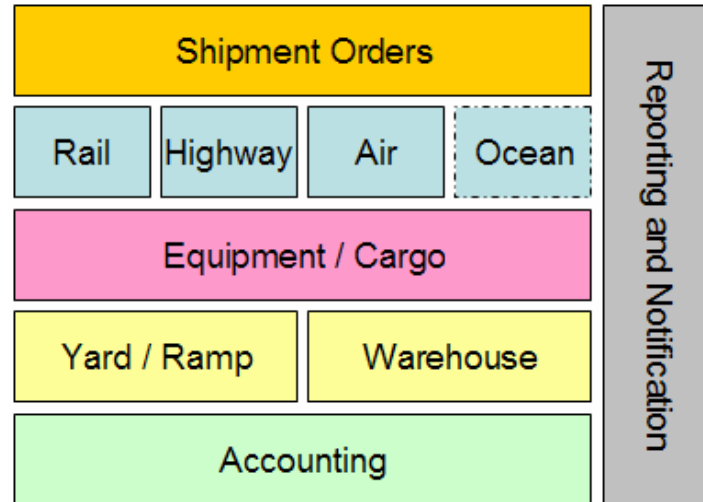


Figure 1: SCLA Required High-level System Functional Areas

1.4 The Integrated Tracking System: A Supporting Service

The IP-MTOPS will be supported by another service proposed for development by SM21, the Integrated Tracking System⁵ (ITS), which is itself composed of a series of distributed services loosely coupled through a SOA framework. The ITS will provide an important service to IP-MTOPS: the management of the flow of freight and assets to and from the SCLA. The ITS will provide track and trace services to IP-MTOPS and will be composed of:

- Existing services provided by SCLA terminal and distribution center tenants and
- “Gap-filler” value-added services that might require development by SM21 and SCLA.

Like IP-MTOPS, the ITS SOA design supports a stepwise (incremental) development and deployment effort that will lead to the IOC, as defined in the Strategic Mobility 21 - Integrated Tracking System Analysis and Concept Design document.

1.5 The Strategic Mobility 21 Collaborative Web Portal

The Collaborative Web Portal will both be supported by and provide services to IP-MTOPS (ITS services would be provided through IP-MTOPS). The Strategic Mobility 21 Web Portal Report provides the design for the Web Portal, which will provide collaborative planning and modeling tools for SCLA and the Regional Metropolitan Planning Offices (MPO). The Web Portal will receive its operational data primarily from IP-MTOPS. The Web Portal Report provides more details on the portal functionality.

1.6 SCLA Enterprise Architecture

The IP-MTOPS is a major component of the overall SCLA Enterprise Architecture proposed by SM21 and depicted in Figure 2 below. As depicted, the IP-MTOPS is based on a SOA structure and will receive, as a minimum, additional services from the SM21 ITS and the SM21 Web Portal, which are also based on a SOA architecture model. The SCLA-Functions and required

⁵ Hereafter in this document referred to as the ITS.

services will be satisfied primarily through tenant (business community) owned operating systems such as the BNSF Oasis Intermodal Terminal Management System. Paragraph 16.0 provides a description of the proposed military and commercial SCLA external system interfaces. Combined, the SOA structures create the proposed Enterprise Architecture for SCLA, which is designed to enable stakeholders to share and collaborate in a distributed environment without the need for a single user interface.

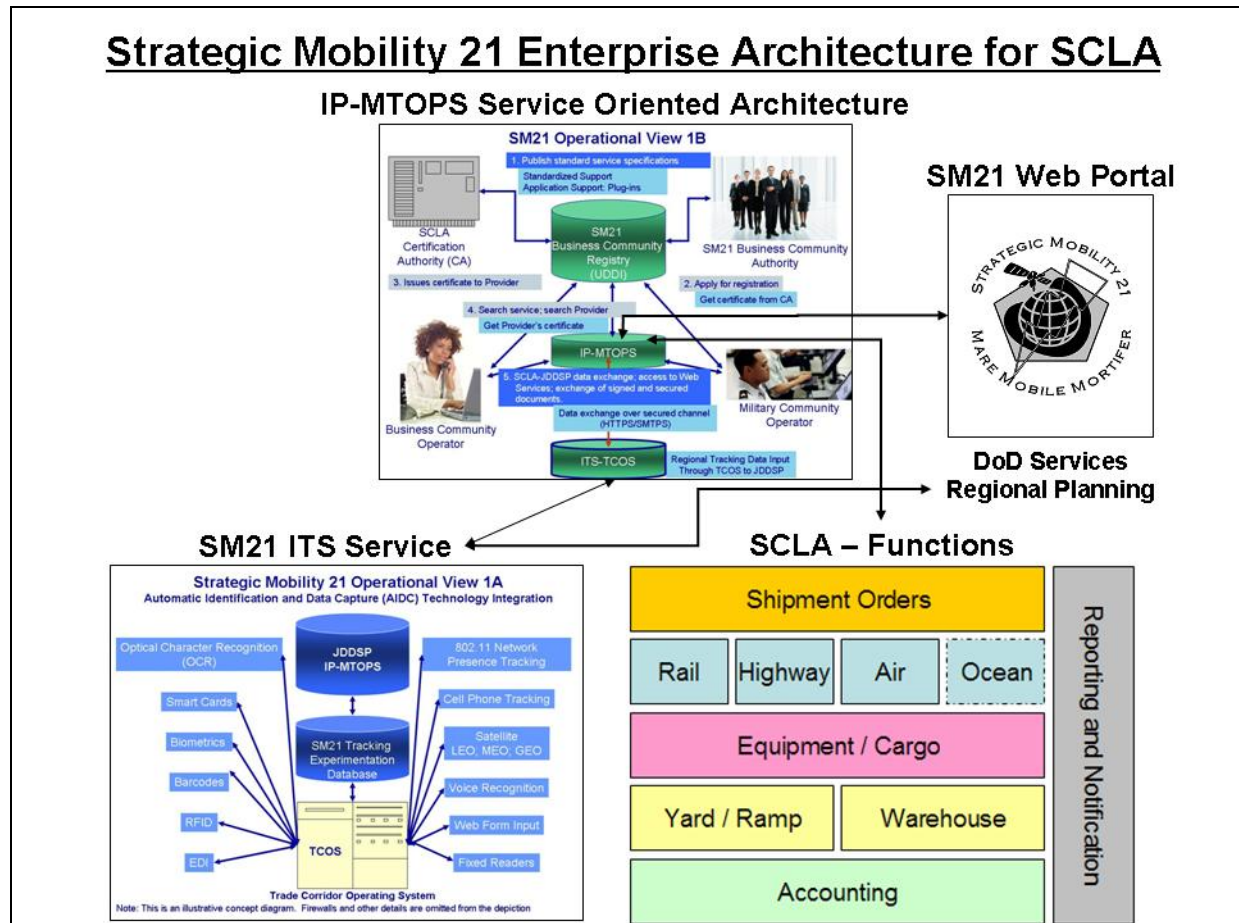


Figure 2: SM21 Proposed Enterprise Architecture for SCLA

1.7 Strategic Mobility 21 Background

Strategic Mobility 21⁶ (SM21) is an operational level concept that merges planning and execution of both commercial freight operations and the deployment and sustainment of joint military forces within a single construct of a Joint Deployment and Distribution Support Platform (JDDSP). Figure 1 below provides an overview of the SCLA facilities that will host the prototype JDDSP and supporting IP-MTOPS. As depicted in the Figure 1, the SCLA will include a dual-use multi-modal yard facility; an intermodal yard facility; trans-loading operations; rail served industrial operations; and warehouses along with multiple air cargo operations. The IP-MTOPS will enable collaboration between these facilities, mode operators, and shippers using the SCLA - both commercial and military.



Figure 3: Southern California Logistics Airport

The JDDSP can be described as a dual-use transportation node that will be developed to seamlessly integrate with and concurrently support the end-to-end military and commercial distribution network. The inland multi-modal port or transfer facility, a key component of the JDDSP, can be described as a central node on a dual-use regional agile distribution network.

⁶ Strategic Mobility 21 is a Congressionally mandated and independently funded applied research program through the Office of Naval Research. The program is conducted under the auspices of the Center for the Commercial Deployment of Transportation Technologies (CCDOTT), a government-industry academic collaborative enterprise.

Each of the rail, truck, and air terminal operations will employ commercial operating systems owned by their respective companies.

2.0 SERVICE ORIENTED ARCHITECTURE - REFERENCE MODEL

As previously defined, this specification supports the stepwise deployment of the IP-MTOPS that will evolve using a SOA framework. The SOA concept has received significant interest within the software design and development community, which has resulted in the proliferation of many conflicting definitions of SOA. To mitigate this problem, the SM21 program has selected a SOA reference model developed by OASIS (Organization for the Advancement of Structured Information Standards), a not-for-profit, international consortium that drives the development, convergence, and adoption of e-business standards. Whereas SOA architectural patterns (or *reference architectures*) may be developed to explain and underpin a generic design template supporting a specific SOA, a **reference model** is intended to provide an even higher level of commonality, with definitions that should apply to *all* SOA⁷.

The selected reference model is an abstract **framework** for understanding significant relationships among the entities of the SCLA-JDDSP. It enables the development of a specific architecture using consistent standards or specifications supporting the SCLA-JDDSP Business Community. For additional background and model information, please refer to the complete reference model documentation, which is available within the SM21 PMIS or at http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=soa-rm.

The SM21 program goal for using this reference model is to define the central concepts of service oriented architectures, and establish a vocabulary and a common understanding of SOA for all program stakeholders both internal and external. It will provide a “normative reference” that will remain relevant throughout the SM21 SOA stepwise development and implementation, irrespective of the many future technology evolutions that will influence SOA deployment.

The IP-MTOPS architecture will be developed using the requirements identified in this document. The SM21 supported IP-MTOPS Architecture development will not be done in isolation but will account for the goals, motivation, and requirements that define the actual problems, or gaps, being addressed in both the commercial and military sectors.

3.0 INLAND PORT MULTI-MODAL TERMINAL OPERATING SYSTEM (IP-MTOPS)

The IP-MTOPS will manage the exchange of structured and unstructured data provided by freight and asset management software systems employed for moving freight into, out of, and within the SCLA. Collectively these external and internal facility/information systems provide the information necessary for the IP-MTOPS to perform the manipulation, temporary storage, retrieval, transmission and presentation of actionable information. The primary IP-MTOPS function is to provide the timely, actionable data needed by decision makers to manage terminal and inland port operations. This is accomplished through electronically generated information reports that are integrated from the data provided by the various operating systems within the SCLA and that support freight movement through the SCLA and made available through the appropriate user interface.

⁷ Reference Model for Service Oriented Architecture 1.0, Public Review Draft 1.0, OASIS, 10 Feb 2006, page 4

The IP-MTOPS will be used for the dissemination of actionable information to individual terminal personnel and for automating information collection, consolidation, and analysis efforts at the terminal and provided to internal and external SCLA-JDDSP customers. IP-MTOPS will be deployed using a network service architecture designed to share information worldwide via Internet or Virtual Private Networks (VPN). The IP-MTOPS Architecture will support the stepwise employment of XML and Web Service technologies designed to specifically support the SCLA-JDDSP Business Community of users.

The IP-MTOPS will be focused on supporting the functional management associated with controlling the inland port's physical operational flow of transportation assets, cargo and personnel. The IP-MTOPS must be capable of supporting the requirements of both military and commercial shippers. The system will not only support the throughput of shipments via a single mode but must also support modal diversions and shipment trans-loading operations for both import and export shipments.

Figure 1 provides a visual, high-level depiction of the required functional areas that will be filled by multiple information management systems – most will be tenant owned. In addition to the functional areas depicted in Figure 1, which directly support the physical flow of shipments through the terminal, the integrated system must also support general technical, customer integration, reporting, administrative, shipment security and inventory management functions. These additional functions are outlined below and are provided as detailed requirements later in this document:

- General Requirements (Section 2.0) define how the commercial operating software systems support all shipment modes in terms of shipment planning, customer support, and industry controls.
- Inventory Management (Section 3.0) defines the requirements that the commercial multi-modal terminal operating software system must support for the proper management of the various equipment types assigned to and used in the terminal. This includes the maintenance and repair of equipment, equipment reservations, and the wireless monitoring of equipment used at the terminal.
- System Reports (Section 13) provides the requirement to support both ad-hoc and customer specific reports using specific reporting formats and processes.
- Integration Requirements (Section 14.0) is focused on the capability to seamlessly interface with disparate external systems using various communication methods and message formats.
- Technical Requirements (Section 15.0) define the commercial operating software systems' requirements associated with such topics as system availability, the numbers and types of transactions that will need to be processed, the types of technology components that need to interact, and the access and security standards.

The functional areas depicted in Figure 1 and the associations with the requirements contained in this document are outlined below:

- Shipment Order Management (Section 4.0) is depicted as a bar across the top of the four transportation modes and linking into the reporting and notification requirements. The commercial multi-modal terminal operating software system must be capable of proper management and integration of shipment orders transmitted directly by the shipper enterprise resource systems (ERP) or through the transport mode operators that support the terminal. Customer ERP systems, in support of corporate supply chain management operations, must be able to communicate requirements for modal diversions and trans-loading. This is critical for commercial import shipments and efficient military outbound force deployments and sustainment shipments.
- Modal Management (rail, highway, air, and ocean) is represented by the individual blue blocks between the shipment orders that control the use of a specific mode and the equipment/cargo bar that represents the shipment assets and cargo transported by the individual modes. The functional requirements that the commercial operating software systems must satisfy to support each mode are defined in Sections 6.0, 7.0, 8.0, and 10.0.
- Yard and Ramp Management (Section 5.0) includes the requirements for the commercial multi-modal terminal operating software system to initially set up and modify, when required, the terminal in terms of physical layout. The system must also support the layout and availability of fixed and mobile material handling equipment.
- Warehouse Operations (Section 9.0) depicted in Figure 1 includes the requirements for the commercial operating software systems to configure warehouse logical zones/areas and manage the temporary storage and transfer of shipments. This functional requirement area includes Load Optimization (Section 9.1)
- Accounting Requirements (Section 11.0) includes the requirement for the operating software systems to support the Sarbanes-Oxley (SOX) controls through the accounting processes.
- Notifications and Alerts (Section 12.0), which is represented by the integrating end bar in Figure 1, includes the system requirements to manage operational and customer business-critical issues and resolve them early before they impact the shipment process. The requirements defined in Section 12.0 will enable military and commercial shippers to better control their supply chains and equipment distribution functions.

Appendix A provides the information scenarios the IP-MTOPS system is expected to support. The base scenarios include: Ocean Import, Ocean Export, Highway Arrival; Highway Departure; Inbound Rail, and Outbound Rail for both commercial and military shipments. Additional requirements to be provided by IP-MTOPS are expected to be associated with Air Cargo arrival and departure functions.

3.1 Application Development Scenario

This specification supports the planned approach of gradually introducing the SCLA-JDDSP stakeholders to Web Services. SM21 acting on behalf of the SCLA local authority will establish the neutral, not-for-profit entity needed to establish and maintain a Private Universal Description, Discovery, and Integration (UDDI) Registry⁸ for the SCLA-JDDSP Business Community (or Logistics Community of Practice (LCOP)). Further, SM21 will support the development of a secure

⁸ The UDDI specification, currently maintained by OASIS, is not a specification for describing Web services – UDDI is simply used as the yellow pages of Web services.

environment to ensure secure document and data interchange. Figure 3 below provides an overview of the SCLA-JDDSP Business Community Service Infrastructure which creates the IP-MTOPS.

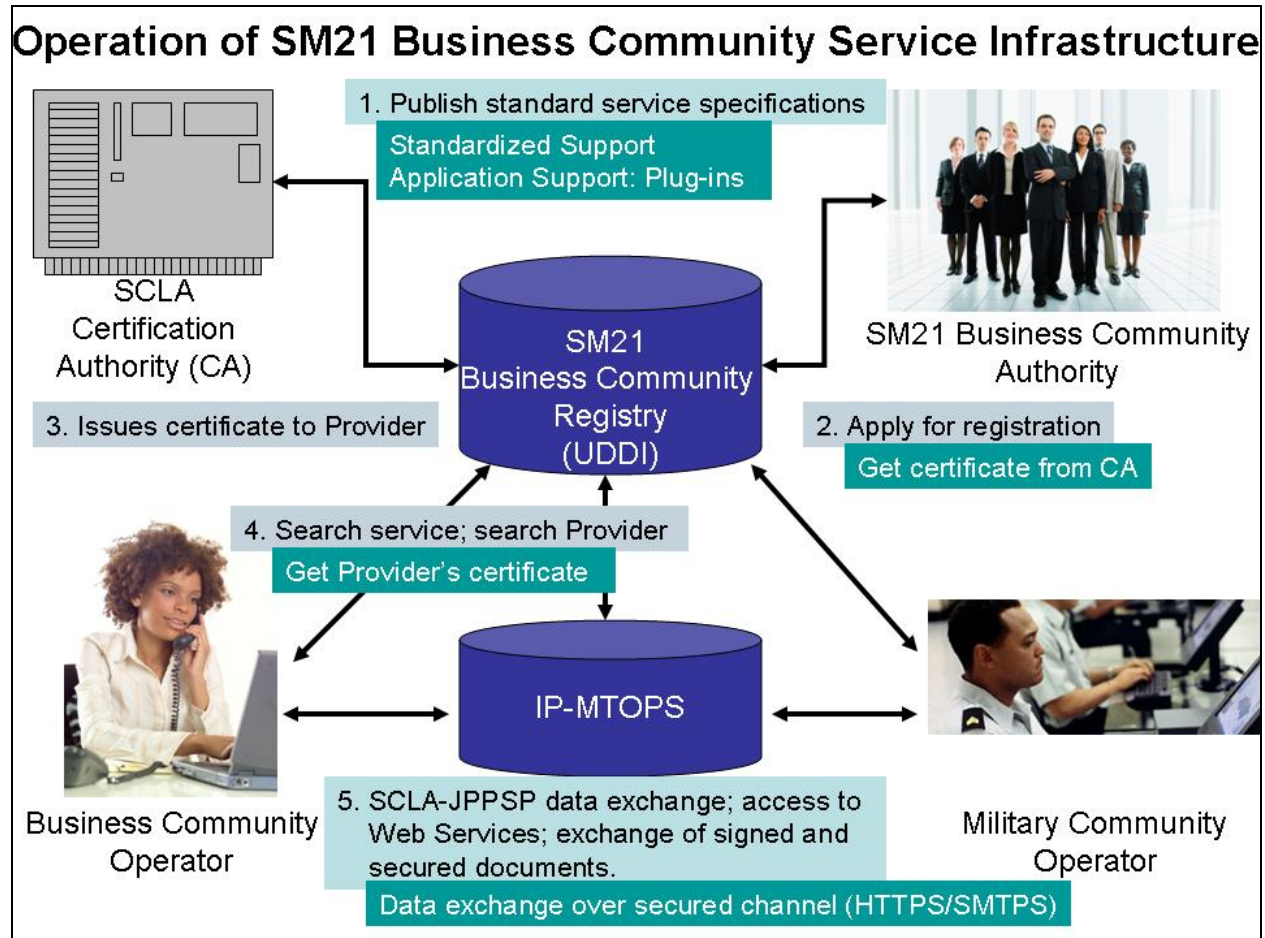


Figure 4: Operation of the SCLA-JDDSP Business Community Service Infrastructure

The initial use of the requirements defined in this specification will be to work with SCLA to identify the current and future facility tenant activities and map their intended operating systems against the requirements in this document. The focus of this will be to begin planning both the “on-boarding” of the tenants’ information systems (data integration with the IP-MTOPS and ultimately registration in the UDDI) and the capability gaps. Capability gaps will be identified by matching the requirements within this specification against the tenant capabilities. The gaps will be filled with the acquisition of additional commercial software services or through the development of Web services.

The IP-MTOPS application development is centered on interfaces that enable collaboration and the exploitation of structured and unstructured data by techniques such as data mining. As noted above, commercial off-the-shelf software such as intermodal operating systems and to some extent multi-modal operating systems already provide the capabilities to produce status interfaces and to manage the workflow at supported facilities. The IP-MTOPS will not duplicate the interfaces found in these commercial products. Instead, through the use of this specification

and other SM21 requirement development work, the IP-MTOPS development will focus on identifying and filling requirement gaps.

As an example, SM21 identified a military capability gap between ship stow planning, ship load sequencing and rail car load and movement planning for force deployments. Planning a surge deployment to minimize the impact on port operations, while decreasing deployment timelines, creates the requirement to sequence the arrival of rail cars so that equipment is delivered to a strategic port in the correct ship (deck and hold) loading sequence. One known gap is that there is no mechanism today to determine the order that equipment will be needed at the port to put it on to a ship to achieve a particular stow plan. This is done manually and in real time today, selecting equipment from the set of equipment available at the port. Today this often means moving the entire unit equipment set to the port and then loading potentially one piece at a time instead of loading the maximum number of decks and holds concurrently through all available ship entry points. There are other even more significant issues surrounding coordination with Class I railroads but at this point it is sufficient to say that the SCLA-JDDSP will be able to develop Web services to bridge this significant capability gap.

3.2 Document Development and Use of Service Requirements List

The following paragraphs (4.0 General Requirements through 17.0 Technical Requirements) will be used to determine what services must be provided by IP-MTOPS to ensure the SCLA Enterprise Architecture is complete for dual-use operations. The only reason for having IP-MTOPS provide a specific service is to ensure that the service is available within the SCLA Enterprise Architecture. In other words, if the service is available and accessible by other systems, then IP-MTOPS does not need to provide the service.

The following is a specific example of how the list will be used. Under General Requirements (Paragraph 4.0 the first bullet) there is a service requirement to assist in strategic and tactical planning of all terminal operations and shipments. This service would allow SCLA to ensure that the facility was ready for the ever changing daily operational environment that might impact more than one operating entity at SCLA. This would be the case when a military force was deploying through the SCLA en-route to combat operations in a surge, or initial deployment configuration, requiring basic loads of ammunition and explosives to be loaded in the combat vehicles. The impact on SCLA for this type operation would be significant and would impact security operations, land usage, rail and highway operations. How this service is provided by or through IP-MTOPS would be resolved during the joint SCLA-SM21 enterprise architecture development process.

As an initial step in the development of this document, an exhaustive literature search was conducted to review the functions, processes, and procedures associated with multi-modal terminals including both existing and future terminal designs. The list of references included in the final development of this document is provided in Appendix C. In addition to the use of outside references, the extensive experience of the project team members with the direct development of terminal operating systems greatly enhanced the final product.

The dual-use SCLA-JDDSP physical facility design includes hardware, software, and infrastructure components to provide the required military and commercial services. These

services and designs are provided in the series of deliverables issued from 2004 through June 2007. The references are contained in Appendix C.⁹

The following sections provide the multi-modal terminal operating system functional requirements that must be supported by services that were identified to support the SM 21 program and the development of the JDDSP multi-modal terminal.

4.0 GENERAL SERVICE REQUIREMENTS

The general service requirements associated with the SCLA Enterprise Architecture to enable a comprehensive, integrated web-enabled solution to support SCLA air, ocean, rail, and highway operations. This includes the management of freight, military air passengers, inland port infrastructure, business processes, and transportation assets.

The individual general service requirements are provided below:

- Assist in strategic and tactical planning of all terminal operations and shipments.
- Provide visibility to management, operating personnel, customers and business partners, including alerts for out of plan or near-out of plan events.
- Track and control all cargo and terminal assets (personnel, equipment, and land).
- Ability to affiliate DoD Transportation Control Numbers (TCN) with commercial shipment data
- Must be able to capture and store shipment status events across transportation modes for full end-to-end shipment visibility.
- Ability to maintain and track service/ operations issues via on-line *Problem Log*.
- Provide flexible external communication for inbound and outbound shipment flows across multiple transportation modes.
- Provide searchable audit trails are required for critical transactions.
- Must record date, time and source stamps on all electronic status update transactions.
- Must comply with industry Sarbanes-Oxley (SOX) controls.
- Must support any Homeland security requirements for international container terminals.
- Report on and support HAZMAT compatibility across all modes.
- Support the *Mission* concept for tracking cargo passing through the terminal.
- Ability to plan, in advance, containers directly from one mode to another.
- Ability to support multiple languages and currency for external communications.
- Provide terminal managers the ability to view and create custom dashboards that contain terminal-wide performance indicators, such as train performance, yard utilization, and truck turn times.
- Ability to dispatch *Work Orders* to yard personnel using radio data terminals (RDTs) to efficiently manage operations and monitor progress in real-time.

⁹ While service-orientation is a concept found in a broad variety of applications, this document focuses on the field of software architecture for the IP-MTOPS. The concepts and relationships described may apply to other "service" environments; however, this specification does not completely account for design requirements outside of the software domain.

- Must be able to manage en-route, arrived and departed shipments and its cargo wirelessly from RDTs or handheld/ tablet devices.
- Ability to create terminal metrics definitions to match performance measurement objectives for air, vessel, crane, rail, MHE (Material Handling Equipment), yard, and gate, including rail gross and net productivity, ETC, delay, yard utilization, truck turn time, number of trouble transactions and MHE productivity.
- Provide a graphical view of terminal/ warehouse layout and operations with configurable color palettes and filtering and provide instant information pop-ups.
- Provide an interactive dashboard of electronic errors by reject reason/ message set/ trading partner/ location.
- Ability to the handle, alert and correct of out-of-sequence events and rejections.
- Must distinguish events in multiple time zones.
- Support multi-currency and unit of measure (UOM) conversions.
- Monitors activities with respect to user defined service levels.
- Ability to support spell check function on all free-form text fields.
- Must provide online context sensitive *Help* and customization at field level.
- Highly configurable and business rule driven.
- Apply business variable rules for archiving/ purging equipment history.

5.0 INVENTORY MANAGEMENT

- Must be able to store and manage an inventory of various equipment types at multiple locations to support local, national and global activities.
- Must capture status events from air, ocean, rail and truck transportation modes through manual and electronic formats in near real-time response.
- Ability to view all status messages from various sources on equipment to include estimated time of next key event.
- Ability to view all terminal flows, past and pending actions and events performed on the equipment such as movement and storage history, associations, mechanical data updates, waybill changes and applied charges.
- Ability to easily access all associated data relevant to an inventory item such as pick-up numbers, origin and destination city site and rail ramp codes, notify party information, container size, gross weight and HAZMAT details.
- Provide the ability to display dashboard views of inventories including: units picked up and en-route, units received at destination, units dropped off, units available.
- Ability to review the equipment manifest down to the line item whether transporting serial or bulk cargo.
- Provide the ability to archive equipment inventory levels to support trend analysis.
- Ability to provide statistics regarding the current and historical state of the inventory and available storage locations.
- Provide the ability to attach and easily retrieve scanned documents and notes associated with a particular piece of equipment and other portable equipment such as gensets.
- Provide the capability to add equipment to the system; update equipment specifications; delete equipment from system if permanently removed due to damage etc.; ability to add or update based on single equipment number or range of numbers.

- Capability to view and manage equipment associations (e.g. container to chassis, container to railcar and chassis bundles).
- Automatically create system generated holds and permissions based on configurable business rules such as restricted or prohibited commodities, mechanical holds (based on equipment type or condition), Homeland Security, U.S. Customs or routing.
- Provide access to inventory information including available, reserved, on-hold, customs and bad order equipment.
- For railcars, provide the ability to capture and update specification data by range of car numbers and single car number. Data should include: physical characteristics including ATR (distance to top of rail to lowest part of car) and center of gravity; American Association of Railroads (AAR) type, loading capabilities average by car and well; owner; build date; manufacturer name, address and contact; date placed online; cost; daily car hire rate; hitch configuration; stacking capacity.
- For aircraft, provide the ability to capture and update specification data by tail number range and single tail number. Data should include: physical characteristics; class type, loading capabilities; payload limits; owner; build date; manufacturer name, address and contact; date placed online; cost.
- For containers, trailers and chassis, provide the ability to capture and update specification data by range of equipment numbers and single equipment number. Data should include: physical characteristics; type, tare weight; grade; owner; build date; manufacturer name, address and contact; date placed online; cost; state registration information (for over-the-road equipment); license plate number.
- Maintain a central repository of information for all owned and leased equipment acquired through any source.
- Must be able to manage fleet contracts and leases for all types of equipment.
- Must be able to identify in the system that operates and owns the equipment.
- Must be able to monitor regulatory compliance for each equipment type.
- Ability to assign equipment to a designated pool or location.
- Provide the ability to flag equipment for restricted use (i.e. long-haul).
- Must be able to show available equipment by location in near real-time.
- Provide modeling tools for strategic equipment fleet sizing decisions. Key decision criteria are equipment utilization, fleet size, loadings, transit times, equipment cycle times, and equipment costs.
- Ability to display third party lost or destroyed equipment cost recovery information including third party billed, loss type code, amount billed, amount collected, comments field
- Provide the ability to flag equipment for sale (mass update) based on user selected criteria.
- Ability to support lease contract information on-line (using imaging or softcopy versions).
- Optimize the number of days facility owned containers, trailers and chassis are under the control of customers, truckers, rail carriers and partners by providing online displays and reports required to support management efforts to facilitate the return of owned equipment.

- Ability to capture and manage lease contracts/ agreements online including key information such as (contract termination, age, manufacturer, etc.)
- Ability to image and link new addendums or riders to existing lease contract must be able link multiple addendums or riders to a single contract and maintain a chronological order.
- Ability to image all lease contracts and view on-line by contract or equipment number.
- Ability to exchange information automatically (electronically) to and from the leasing companies. i.e. changes to equipment information (on-hire and off-hire)
- Ability to apply mass changes to equipment records based on changes to one or more contracts (i.e. change the lease end date for all equipment on the following five contracts).
- Provide the ability to report miles by car by state to leasing agent.
- Must be able to track/ apply Mileage Credits.
- Plan and manage the on-hire and off-hire of leased assets, and disposal of lost or damaged equipment.

5.1 Maintenance and Repair (M&R)

- The system must accept and confirm the receipt vendor invoice submissions electronically or through a web-form.
- The system must validate the vendor's contract expiration date as part of the invoice review process and support contracts without expirations.
- The system must be able to differentiate between an original invoice and subsequent revisions to the invoice.
- Must exhibit all necessary SOX controls for the invoice process.
- Systematically apply validations and edits to defined fields against a common authorized materials table at the line-item level of detail and apply logic based on user configurable business rules such reject any invoice that exceeds the purchase order amount.
- The system must allow the ability to decline a repair invoice in its entirety or at the line item level.
- Maintain authorized vendor AAR *Job code/ Why Made code* combinations.
- Provide analysis of repairs performed by damage type, cost, equipment type, location (including city/ site), material, vendor, accounts payable exception
- Provide the ability to store and retrieve digital photos of damage.
- The system must validate authorized repair status against the list of *Do Not Repair* (DNR) equipment.
- Provide the ability to review and update equipment condition to flag damage severity and inspection.
- The ability to flag equipment to be taken out of service, to schedule annual maintenance and notify operations as well as other interested parties.
- Provide the ability to keep internal mileage tables up to date and make sure miles are assigned to routes based on carrier distances for each leg.
- The system must support uploading AAR authorized materials tables and (Universal Machine Language Equipment Register) UMLER railcar data.
- Capability to report equipment additions, number changes including mechanical specification data to the AAR.

5.2 Reservations

- Provide a detailed audit trail of all reservation activity by user for reservations made, changed, canceled, etc.
- Provide the ability to reserve equipment by characteristics such as size, type, and grade or by a specific number.
- The system must confirm receipt of reservations to the customer via an email confirmation option in the customer profile.
- View electronic reservations submitted by customer, date or container number.
- Must provide the ability to view, add, update and cancel an order.
- Must be able to tie one reservation to many equipment records.
- Allow or prevent specific units or groups of equipment targeted to specific destination based on configurable rules.
- The system must support assignment of reservations to a *Wait List* category and maintain visibility until capacity becomes available.
- When reservations expire, containers are *unreserved* in the system to make them available for another customer.
- Ability to add user notes to a reservation.
- Ability to track and charge customers for reservations not picked up.
- Ability for operations to monitor a unit picked up against a reservation including trucker ID (SCAC code) and trucker name.
- Access to inventory information including available, bad order equipment, reserved equipment including the customer reserving the container and the date of reservation, per diem rates and reservation charges.
- Ability to allocate containers that have been in the yard the longest using the in-gate date.
- Ability to substitute equipment inventory of another size in cases where there is a shortage of one equipment size and/or a surplus in certain equipment size/types.

5.3 Wireless Monitoring

- Must be able to integrate with major Global Positioning System (GPS) vendors for satellite tracking of yard equipment (i.e. MHE), railcars and containers.
- Must be able to configure telemetry devices over the internet.
- Ability to monitor reefer temperature, vent, humidity, oxygen, and carbon dioxide information.
- Must have alerting on user defined events and thresholds (e.g. temperature +/- 10 degrees for more than 15 minutes for temperature sensitive cargo).
- Provide the ability to interrogate electronic door seals and Radio Frequency Identification (RFID) tags on equipment to allow for terminal personnel to maintain wheeled and grounded container inventories in the yard, in real-time with ruggedized RDTs and wireless hand held devices.
- Must be able to employ readers capable of interrogating all passive and active tracking tags

6.0 SHIPMENT ORDER MANAGEMENT

- Must be able to electronically tender an order to multiple carriers over multiple modes of transport (e.g. e-mail, EDI, fax).

- Must be able to accommodate international origin and destination locations as well as multiple currency amounts.
- Must have ability to systematically apply validations and edits to defined fields during waybill information entry.
- Ability to view electronic shipping order messages by customer, date or container number as when the equipment was billed; submitted and accepted by the carrier.
- Ability to automatically or manually retransmit shipment orders to carriers and any other required party.
- The ability to print/ FAX a shipping order in a standard format to send to the carriers.
- Ability to create and organize templates for ease of standardizing and generating shipment orders.
- Ability to maintain customer profiles detailing key contacts, addresses, notes, preference of notifications and authorized order templates.
- Must be able to store data for a shipment that is not scheduled to move for several weeks or more in the future.
- Ability to do a mass tender of equipment to a carrier (pool dispatch).
- Support one-way contract details including: origin and destination; pick-up volumes and time information at origin and destination; repositioning rates; free time allowed; per diem rates to apply after free time.
- The ability to transload equipment on orders, updating equipment status with the billing of new container on same order.
- Ability to automatically accept HAZMAT orders electronically and control by the customer profile.
- The ability to update an order for *Service Recovery*, giving visibility to operations of the change, but keeping the same rate quote to the customer.
- Provide diversion information to all involved parties via system alert to selected users.
- Provide a system generated order hold based on established requirements such as restricted or prohibited commodities, mechanical holds, routing, Homeland Security and U.S. Customs.
- Ability to automatically reject an order based on equipment, commodity and location rules.
- The ability to assign and control priority of orders based on configurable rules.
- Ability to support and monitor priority customers/ accounts/ shipping orders.
- Must be able to track shipments in the system based on various reference numbers and attributes such as Equipment Number, Shipper, Shipper Reference, Origin, Destination, Notify Party, Beneficial Cargo Owner, Status, and Priority.
- The ability to view and report on full Routing information.
- Automatic generation of dray orders related to the applicable Route.
- The ability to view and report on the current and historic status of a shipping order including all modifications/corrections, routing information, revenue and cost information, invoice status and notes (aircraft, vessel, train, railcar and container level) and pick-up numbers.
- Access to the details and current status of each equipment associated with an order.
- The ability to enter and view all notes pertinent to a shipping order.

- Ability to include special instructions on shipment orders such as Customs, hazardous, protective service, overweight and oversized.
- Must be able to capture and store imaged Bill of Landing (BOL) document and associate with a shipment.
- Must be able to capture and store imaged Port of Discharge (POD) documents and associate with a shipment.
- Ability to view and update U.S. Customs information.
- Ability to set up multiple legs with the same origin and destination and to distinguish between different criteria: vendor, priority, mode, mode of transport.
- Support both Rule 11 and non-rule 11 shipment orders.
- The ability to flag special/ priority services on a shipping order and provide alerts when the terminal did not meet the service agreement in order to make adjustment prior to generating the customer invoice (assessorial charges).
- Ability to automatically close shipment order upon configurable termination rules.

7.0 YARD OPERATIONS

- Must have a means to initially set up the terminal in terms of physical layout, and available MHEs.
- System must permit frequent modifications to the terminal layout and inform personnel.
- System must allow for permanent modifications (yard expansion, acquisition of additional MHEs, etc.)
- System must allow for temporary changes (out of order equipment, unavailable area of the yard due to weather, repaving, security, contamination, etc.).
- Ability to provide a graphical view of the physical location of the inventory.
- Ability to provide a graphical view of terminal activity.
- Support both stacked and wheeled storage.
- Support reefer areas and accommodate HAZMAT compatibility.
- System must have the means to set up parking and stacking rules throughout the terminal (tactical and strategic rules).
- System will recommend storage locations minimizing the mixing of stacks and rehandles; will automatically assign containers to optimal positions across the yard, maintaining compliance with hazardous container segregation rules, ensuring proximity to the scheduled loading berth, aircraft or rail track, and distributing for efficient MHE operations.
- Visibility to the current expected train, vessel or aircraft arrival and current expected time of grounding for in-transit orders.
- Ability to manage shift crews and schedules for various terminal activities.
- System will have the capability to optimize work assignments based on yard and equipment constraints, and operating rules such as target moves per hour.
- Ability to derive shipment order information and automatically plan/ apply to terminal activity.
- Perform a single transaction to create multiple activities.
- Perform a single transaction for multiple units.
- Must be able to capture yard location of any equipment dropped at the terminal.
- Must be able to search and report on equipment inventory, status and location.

- Ability for terminal to report summary and detail data for each wheeled slot, each grounded stack, each track, each runway, the shop, slots used, slots available.
- Provide visibility of local movement, assignments and schedule of all equipment in the yard.
- Provide real-time status messages of all yard activities to designated parties.
- Provide comprehensive real-time monitoring of the operation as well as comprehensive statistical performance reporting for management.
- Maintains a full inventory of MHEs and support equipment and maintenance history.
- Management of ground handling documents other than waybills.
- Must be compatible with RF technology standards; support data acquisition from stationary and hand held readers.
- Ability to efficiently track on terminal storage information/ issues that occur in the terminal yard after notification, but prior to the equipment being out gated that may impact the per diem free day calculation.

8.0 HIGHWAY GATE OPERATIONS

- Must support processing orders, performing dispatch functions, managing equipment and drivers, managing critical document images and providing back-office financial information for various types of equipment received at the gate.
- Visibility to the equipment in-gate and out-gate activity including trucker information.
- Ability to interface with dray carriers to provide visibility of cargo movement.
- Provide the capability for appointment scheduling at the gate which will allow a high quality data for planning operations by providing visibility to freight arriving at the terminal to eliminate data entry errors or trouble transactions.
- Provide real-time status messages of gate activities to designated parties.
- Provide gate security measures and controls by capturing relevant data and image inputs and warn of any shipment holds or interchange issues.
- Provide an inspection process for arriving and departing equipment.
- Ability to tie each out-gate container to each reservation for tracking purposes.
- Provide electronic information exchange with UIIA to ensure trucker has a relationship with terminal, and if the trucker does not, provide alerts or prevent the transactions from completing.
- Provide the ability to suspend a trucker's interchange agreement.
- Provide the ability to ban a truck/ driver from the terminal.
- Manage staging area for drivers and their equipment as they wait for the proper staging of the equipment requested.
- Match up cargo and equipment with records of expected arrivals from advanced orders.
- Processes containers, chassis, trailers and other cargo that arrive at the gate.
- Recommend placement location information, including park-or-stack decisions.
- Process outbound gate requests for containers, chassis, trailers and other cargo that will leave by the gate.
- Controls must exist to assure that the container is released to the trucker representing the customer with the valid reservation.
- Match up and record gate departure events with trucker arrivals.

- Provide instructions/ work orders for placement of cargo in the terminal as well as work orders needed to retrieve cargo.
- Determine immediate equipment needs, such as a chassis for yard operations.
- Ability to assign and dispatch moves and open Dray Orders to the truckers by: container number, ramp pairs, train id, car number, availability and locations.
- Provide visibility to missed cross-towns.
- Support the capability to enable authorized truckers and partners to update information and/ or review out-gate equipment and submit dispute documentation.
- Integrate with automated gates, RFID and optical character camera technology.
- Provide ability for personal to wirelessly manage gate operations from ruggedized tablets and handheld devices.

9.0 RAIL OPERATIONS

- Ability to conduct empty rail car distribution and optimization to efficiently allocate cars to meet requirements
- Maintains inbound and outbound train profiles which captures various details including any route restrictions.
- Maintains scheduling information (considers schedule of the integrated system).
- Creates, modifies, deletes and reinstates seasonal and operational schedules.
- Ability to interface with rail carriers to provide visibility of cargo movement.
- Ability to receive inbound consists and generate outbound consists electronically with designated rail carriers.
- Ability to monitor trains in transit, using CLM information, by planned and actual times for the following information; way points, pickups, arrival at destination, cargo availability times.
- Ability to track actual train performance to schedule and time variance using CLMs, including: containers, car and train segments in-transit, off-schedule cars and train segments in-transit.
- Ability for the system to discount bad order railcars from usage.
- Ability to track cars and trains in-transit, late cars and train segments and cars with mechanical problems.
- Ability for the user to add notes for various levels of a train such as train ID block, railcar, well, container.
- Provide equipment and order information on en-route and arrived inbound train consists.
- Match actual arrivals versus planned and allows for manually entered equipment and automated updates.
- Ability to add railcars not updated as *arrived* to a track.
- Process containers, chassis, trailers and other cargo that arrives on an inbound train.
- Notifies customers based on profiles of cargo arrival and availability.
- Provide internal triggers for activities related to the arrival and departure to update train status and equipment action (stay-up, transload, ground, etc.).
- Provide internal triggers for activities related to train spotting and discharge (Rail, car and container level).
- Allocates MHE and crews for dropping inbound and building outbound trains.
- Create work orders for unloading (or trans-loading) operations.

- Determine immediate equipment grounding needs, such as a chassis.
- Recommend placement location information, including park-or-stack decisions.
- Provide instructions/ work orders for placement of cargo in the terminal.
- Ability for the user to add notes to trains, capturing the status at the time the note was taken.
- Provide internal triggers to support the unlinking of railcars from the train, and equipment from the railcars.
- Perform inspection of inbound and outbound equipment and cargo (same as at gate).
- Ability for users to select and view the details of an inbound train and reallocate by block or railcar to another train.
- Provide the ability to reserve railcar slots for customers, products, agreements or line of business.
- Recommends an outbound train plan which can be updated based upon configurable business rules, train profiles and available equipment.
- Creates work orders for loading the outbound train.
- Create works orders as needed to retrieve cargo.
- Ability plan trains based on: vessel voyage ID, train ID, destination blocks, train length, gross weight, commodity, customer and mixed destination cars.
- Ability for the user to assign railcars to a train/ block.
- Ability for the user to pre-block railcars to a destination.
- Ability to plan an outbound train based upon a vessel stowage plan.
- Optimize loading and discharging by matching the next discharge point of a container with the block destination.
- Ability to view what is loaded on a train including planned moves.
- Provide graphical railcar sequence planning and train scheduling.
- Ability to support compressive load and blocking rules with screen warnings.
- Determine percentage of car utilization for each outbound consist.
- Ability to view *Load* vs. *Capacity* for a train (real-time), allowing updates to ensure utilization against plan.
- Provide rail security measures and controls by warning of any shipment holds or interchange issues.
- The system must support railroad pickup numbers (railroads unique number to provide security in the movement of equipment out of their facility).
- Ability to indicate that that the loading of an outbound consist has been confirmed and secured.
- Ability for the system to recognize and record warnings/ errors as a result of confirmed loads record in the system (i.e. violation of loading rules).
- Provide ability identify and track reasons for unused railcar slots and apply notes to outbound train.
- Ability to create and maintain a track list of railcars at the terminal tracks (en-route or available).
- Ability to select a site track and assign or reassign a railcar to the track, in a track position, using a drag and drop method.

- Ability to view existing railcars already spotted and assigned to other trains on the track, and the associated status of each railcar, and ability to compare cars on track with spotting instructions.
- Ability to view departed trains by destination block, train consist, container size, weight, destination and shippers.
- Ability to auto-sequence cars (modify railcar standing order) after loading function is complete.
- Must be able to create a yard switch list once equipment has been moved in system.
- Ability to order railcars for a ramp, either by railcar type or quantity of wells.
- Ability for the user to add power units and applied horsepower of each train.
- Ability for the system to calculate total horsepower, power to weight ratio, and apply minimum rules associated with power and train length.
- Must be able to produce a BOL if required and electronically send to designated parties.
- Print rail waybills in the (Association of American Railroads) AAR standard format.
- Ability to determine the actual ramps that correspond to any route O/D pair.
- Ability to set up generic routes, or to restrict routes to certain shippers, beneficial owners, lines of business, agreements, equipment types, commodity, mode of transportation, equipment load/ empty or movement type.
- Ability to create new routes by copying existing routes.
- Ability to define a status for a given route to govern how the route is used.
- Provide real-time status messages of rail activities to designated parties.
- Provide ability for personal to wirelessly manage rail operations from ruggedized tablets and handheld devices.
- Provide functionality to archive car utilization factors including: voyage ID, train ID, load-discharge locations, total slots per car, car load-ability by platform, total container slots utilized by TEU (twenty equivalent units), total container slots loaded by line of business (LOB), TEUs loaded by LOB and empty moves.

10.0 AIRLIFT OPERATIONS

- **It is assumed that the air traffic control features will be handled outside of this requirements specification.**
- Automate the complex task of air load planning with full consideration given to all individual aircraft constraints, hazardous cargo compatibility, venting and shoring requirements.
- Ability to interface with air carriers to provide visibility of cargo movement.
- Ability to track flights and flights in-transit, late flights and route segments and flights with mechanical problems.
- Store inbound flight and handling documents (scanned images or softcopies).
- Supports operational disruptions and flight monitoring; ability to setup alert notifications based upon events and delays.
- Maintains scheduling information (considers schedule of the integrated system); creates, modifies, deletes and reinstates seasonal and operational schedules.
- Ability to monitor flight schedules, AWB number and the blocking and releasing of AWBs by customs.
- Ability to track actual flight performance to schedule and time variances.

- Ability to maintain manufacturers' specifications and loading constraints for aircrafts.
- Provide estimates of airlift requirements and develops initial load plans for a given equipment list given airlift parameters, delivery method, aircraft type, and allowable cabin loads.
- Ability to provide military passenger manifests
- Enable the ability to prioritize some or all of the cargo and passengers (PAX).
- Support airlift movement of the following categories of cargo: bulk and general cargo, typically preloaded on 463L pallets and transportable by common cargo aircraft; oversize, cargo requiring a C-130 or larger; outsize, cargo transportable normally only by C-5 or C-17; rolling stock, equipment that can be driven or rolled directly into the cargo compartment; and special items requiring particular preparation and handling procedures.
- Provide entire management and monitoring of cargo consignments, from the moment a shipment is delivered to the air carrier or its ground handler, through to the end of the supply chain.
- Manages the ground handling activities associated with export flight handling, including the retrieval of cargo from the warehouse, container and pallet build and eventual loading on to the aircraft.
- Handle all activities associated with the acceptance of cargo and the generation of the relevant documentation.
- Ability to create and maintain an airfield list of aircrafts (en-route or available).
- Automatically accepts and processed freight waybill (FWB) messages, and creates air waybill (AWB) records.
- Prints air waybills in the International Air Transport Association (IATA) and Air Transport Association of America (ATAA) standard formats.
- Allows air waybills to be put on hold, and released, as necessary, and maintains a full audit trail.
- Ability to view *Load* vs. *Capacity* for an aircraft (real-time), allowing updates to ensure utilization against plan.
- Provides airlift security measures and controls by warning of any shipment holds or interchange issues.
- Support flight build-up preparation by showing the status of flight load plans, and by generating work orders to ground handling crew and MHE as necessary.
- Generates freight flight manifest (FFMs) messages automatically, and dispatches them to all participating partners.
- Allows for flight capacity segmentation and control by stations, customers, customer groups, products and agreements.
- Produces load statements in order to accurately calculate the load balance of the aircraft.
- Provides instructions/ work orders for placement of cargo in the terminal.
- Automatically assigns storage location (according to type of cargo and warehouse configuration).
- Generates work orders and assigns crew for build-up and breakdown operations.
- Maintains a full audit trail of offloaded shipments, and informs all relevant parties.
- Compares breakdown documents with the flight manifests and the warehouse upon completion of flight breakdown, and identifies discrepancies.
- Automatically flags consignments that are ready for collection.

- Produces delivery orders and transmits to customs, if required.
- Closes the flight after departure; sends a departure status message to the partners.
- Support reservations, capacity control and airfield capacity management.
- Analyzes and generates reports on pre and post flight yield/ load factor.
- Sets preferred routes for O/D pairs.
- Dynamically builds routes directly from flight schedules based on defined rules, type of cargo and service class.
- Maintains connection time data for stations.
- Prepares flight release documentation.
- Arrives shipments from a flight; generates arrival and transfer manifests.
- Maintains full repair histories for each flight and generates reports.
- Ability for the user to add notes for various levels of an airlift such as flight ID, pallet, container.
- Provide real-time status messages of airlift activities to designated parties.
- Provide ability for personal to wirelessly manage airlift operations from ruggedized tablets and handheld devices.
- Manages and controls bulk stock to support operations such as fuel and deicing chemicals at the airfield and other locations

11.0 WAREHOUSE OPERATIONS

- Ability to configure warehouse to logical zones/ areas.
- Creates work orders for warehouse operations.
- System must permit frequent modifications to the warehouse layout and inform personnel.
- System must allow for permanent modifications (storage expansion, acquisition of additional MHEs, etc.)
- System must allow for temporary changes (out of order equipment, unavailable area of the warehouse due repaving, security, contamination, etc.)
- System must have the means to set up picking and placing rules throughout the warehouse (tactical and strategic rules).
- Must be able to search and report on cargo and location.
- Ability to manually enter/ update cargo information.
- Ability to provide a graphical view of the physical location of the cargo.
- System should provide an expert system which will recommend storage locations and activity based upon configurable rules for incoming cargo.
- Fully manages cargo activity, with every aspect of the process being recorded in audit trails.
- Manages all activities associated with the receipt and release of cargo and the generation of the relevant documentation. Reserves waybill numbers from stock for the shipper or agent handling the cargo.
- Ability to view current and historical data (on both electronically and manually generated data) including associated notes and activity.
- Provide the ability to archive cargo inventory levels to support trend analysis.
- Produces the appropriate dispatch documentation and checks against any related holds.

- Provide the ability to attach and easily retrieve scanned documents and notes associated with a particular piece of cargo.
- Automatically create system generated holds and permissions based on configurable business rules such as restricted or prohibited commodities, Homeland Security, U.S. Customs or routing.
- Integrated to RFID stationary and handheld readers to register the received/ released cargo and provide visibility to terminal and relevant parties.
- Communicates build-up transactions to personnel through the use of ruggedized tablets or handheld devices such as pre-flight or pre-train manifests, capture planned waybills and generates a queue to ease departure build-up.

11.1 Load Optimization

- System must be able to optimize container, trailer and pallet loads.
- System must accommodate mixed sizes and weights.
- System must be able to optimize on different packing types.
- System must accommodate refrigerated cargo venting requirements and HAZMAT segregation rules.
- System must be able to consider axle loading/ placement and bridge formulas.
- System must be able to produce a sequential load plan.

12.0 SEALIFT PLANNING

- **It is assumed that the actual operations of a marine terminal will be handled outside of this requirements specification. Stowage plans, vessel details and manifests are required for inland port train planning.**
- Receive status messages from ocean carrier on equipment to include estimated time of next key event.
- Ability to interface with marine carriers to provide visibility of cargo movement.
- Visibility to vessel/ voyage information including the full vessel name.
- Receive manifest information from steamship line electronically.
- Automate vessel planning and generate optimized stow plans based on configurable rules and compliance with vessel stowage and restrictions; enables you to stow one bay at a time or the entire ship by combining stowage factors like type and weight with yard constraints and operating strategy to select the best container to load in real-time.
- Ability to check standard vessel stability and stress calculations in compliance with custom or Lloyd's lashing calculations, as well as Germanischer Lloyd Dynamic Stack Weight requirements.
- Provide graphical stowage sequence planning for train scheduling.
- Customs clearance requirement for port entry; ability to connect to U.S. Customs Automated Manifest System.

13.0 ACCOUNTING

- Must exhibit the necessary SOX controls through the accounting process.
- Maintain a centralized corporate customer profiles module including support for multiple customer addresses and contact methods.
- Must be able to store/ reference customer numbers as part of a customer profile.

- Ability to create repetitive invoice and payment templates.
- Provide the ability for direct billing of customers for waybill, ground storage and handling charges.
- Recognizes various payment methods, and accept more than one payment method for a single shipment.
- Provide flexibility in generating/ delivering invoices electronically.
- Provide flexibility in receiving/ processing invoices electronically.
- The dispute process should identify any invoices (down to the line items) that are disputed; capture the dispute date and reason; and the resolution date and description.
- Ability to add additional charges to a dray order e.g. chassis add-on's (chassis returns) and double drays (e.g. trucker is directed to move container to another facility because rail billing is not in place or gate arrival missed the cut-off time).
- Provide access to the Tariff Surcharges used to generate the customer invoice; hazardous, peak season, fuel surcharge, Alameda Corridor, Mexico.
- Provide an audit trail of payment information back to the equipment/ cargo inventory activity.
- Ability to modify line items for corrections (pre-billing) or adjustments (post-billing) including creating a duplicate copy for editing purposes and retaining the original record for audit trail purposes.
- The ability to update the route of an order and assign financial responsibility to the carrier of the transport legs.
- The ability to add an accessorial to an order and assign financial responsibility to vendors, customers.
- Invoicing of ground handling agents, carriers and stations for Charges Collect (CC) waybills.
- Access to the current and historical customer invoice.
- Improve accuracy of billing calculations to reduce the number of *unbilled* charges, as well as the number of corrections necessary before invoices can be billed by providing exception reports.
- Ability for the user to add notes for various levels of the billing process.
- Performs automatic rating based on shipment order details.
- Must be able to have configurable rate tables for freight rates and assessorial charges.
- Ability to control the rating hierarchy, the order that key information is matched to the shipping order to decide which rate is applied to each shipping order based on shipper, lane, commodity, etc.
- The ability to view and report on current and historical rate information using a wide variety of selection variables such as customer, beneficial owner, origin, destination, equipment type and commodity.
- Access to view and report on the Pricing Rate used to generate the customer invoice.
- Access to Per Diem Rates/ Revenue charges information/ on-terminal Per Diem exceptions.
- Provide management oversight of billing and collections at the Gate by providing an Aging report for truckers with outstanding balances.
- Ability to review, auto-verify and approve carrier invoices prior to payment for select moves, auto-close orders where applicable.

- Ability to print invoices individually or in batches based on the weekly billing cycle or user preference (i.e. carrier, status, and trucker).
- Need the ability to short pay or partially pay either on an invoice or a balance due the Railroads.
- Provide the ability to process freight payment (revenue accounting) and process non-freight charges from railroads for bad moves, interchanges, etc.
- Access to current and historical payment information.
- Ability to accept billing on revenue empties *with weights* and provide alerts to billing and operations groups.
- Ability to override estimated weight and receive delayed weights electronically.
- Ability to easily configure the start date of the per diem clock and other timed-base rules based on configurable criteria; need to indicate the date on the on-line, printed, and electronic invoice.
- System should issue invoices for equipment returned to wrong location.
- Accounting of interline provisions for CC collections on behalf of other carriers.
- Reconciliation of collections vs. billings for CC waybills and accounting of adjustments.
- Projected vs. actual revenue comparison and accounting of revenue adjustments.
- Export billing or sales submission for specific regional areas.

14.0 NOTIFICATIONS AND ALERTS

- Exception notification should be handled automatically by the system by sending alerts to downstream parties who need to act on the information.
- System must be able to generate notifications by various mediums such as EDI, FAX, e-mail, Interactive Voice Response (IVR) Short Message Service (SMS), Rich Site Summary (RSS) and display on a web page.
- System must allow for user definable notification events.
- Automatically selects desired party for notification and method of preferred notification based on the customer profile.
- Ability to generate alerts when key operational and accounting process exceed predetermined time limits.
- Configure alert thresholds for early/ late delivery warnings, and capacity tolerances.
- Ability to provide alerts for trains/ flights/ vessels running behind schedule to customers.
- Ability to automatically and manually notify or re-notify (notify party) by specific container number or numbers by O/D pair, reference number, priority code; in addition to the ability to be able to notify by train, flight or vessel.
- Maintains audit trails of all notification attempts.
- Notify customers and vendors, providing inventory of out-gated equipment, remaining free time, and accrued per-diem charges.
- Tracks multiple hazardous class codes and UN numbers per container and alerts planners with visual and audible warnings if planned moves generate segregation conflicts in accordance with IMDG rules.
- Ability to systemically notify truckers when containers are available for pickup.
- The system must alert users when a vendor is within system-defined days of archived contract expiration date.

- Ability to create shipping order alerts at the container number level or transport level (i.e. train, vessel, flight).
- Need exception of alert if an invoice is received for car repair and car history shows no record of car going into damage status.
- Allow the system to generate a notice to users if a unit is returned to a destination different from the destination shown on the order.
- Ability to provide alerts when containers have exceeded prescribed time at the terminals and when required dray information is missing.
- Ability to alert equipment group when equipment being billed is not in system.
- Ability to report on-hire/ off-hire activity, track foreign containers and owners of tied equipment, and track chassis under partner or pool control.
- The ability to be alerted to delays or non-departures, grounded or adverse chassis, bad order containers and cars.
- Ability to provide alerts for equipment/ cargo place in *Bad Order* or on a *Hold*.
- Support multi-lingual output.

15.0 SYSTEM REPORTS

- Must be able to build and perform ad-hoc or customer specific reports.
- Must provide a standard set of core reports for each functional area.
- Must be able to send reports across various mediums such as E-mail, FAX, SMS, RSS and FTP.
- Must be able to save reports to various formats such as Microsoft Excel, CSV, PDF, Microsoft Word, Text, HTML and XML.
- Ability to schedule reports for regular runs (e.g. Yearly, Quarterly, Monthly, Weekly and Daily).
- Provide on-line displays with downloadable reports, with data drill down capability.
- Provide reports detailing equipment inventories (by size, type, location, status, tied units, etc.) which provide: status model that reflect stages of equipment move cycle; number of days units are in status; profile of equipment inventory by size (20', 40', 45', 48', 53'), type, and subtype.
- System should report data as to inventory of car types, whether empty or loaded, whether damaged, and current car destination.
- Provide the ability, whether the container is in truck, air, vessel or rail transit mode of designating an expected destination and expected ETA.
- Ability to generate air, vessel and train reports by notify party, commodity, origin and destination.
- Provide exception handling reports for delayed, lost, damaged or out-of-route shipments.
- The ability to report on the current and historic status of a piece of equipment such as yard hostler, MHE, yard hostler, aircraft, vessel, locomotive, container, trailer, tank car, flatcar, chassis, reefer.
- Ability to manage in-transit dray movements with online displays and reports (including shipping order data) by; trucker, train id, vessel id, flight id, dray origin, destination, train/ vessel/ flight cut-off times.
- Provides exception reporting which highlights equipment out-gated without information required to support expediting efforts.

- Provides exception reporting which highlights equipment out past established time limits.
- Ability to generate equipment dwell reports to identify aging equipment by location, days and customers.
- Need the ability to report and analyze trends on all equipment damage related costs for truckers responsible for damage.
- Provide displays and reports that show inspections data including, a list of equipment in a particular location; list of items requiring maintenance (as specified by law and manufacturers specification); additional items found; and generate line items.
- The ability to automatically generate a report comparing days cars used in service vs. days out of service as a measure of performance.
- Report on-hire and off hire quantities for each location for each month and compare to contract provisions.
- Ability to support per-diem revenue free-time exception reporting.
- Report on activities that relate to air, rail or container yard (CY) accessorial charges e.g., flips, grounding storage, etc.
- Report containers in-transit to destination on per-unit or aggregated basis.
- Report containers and chassis inventory by owner or lessor codes.
- Provide reports to manage pool or shared chassis fleets.
- Provide access to J-1 and CY interchange documents.

16.0 INTEGRATION REQUIREMENTS

The integration of both military and commercial systems is critical to the operation of the IP-MTOPS as required to support the SCLA Enterprise Architecture. The figure below provides a representation of the systems potentially requiring integration with the overall IP-MTOPS system.

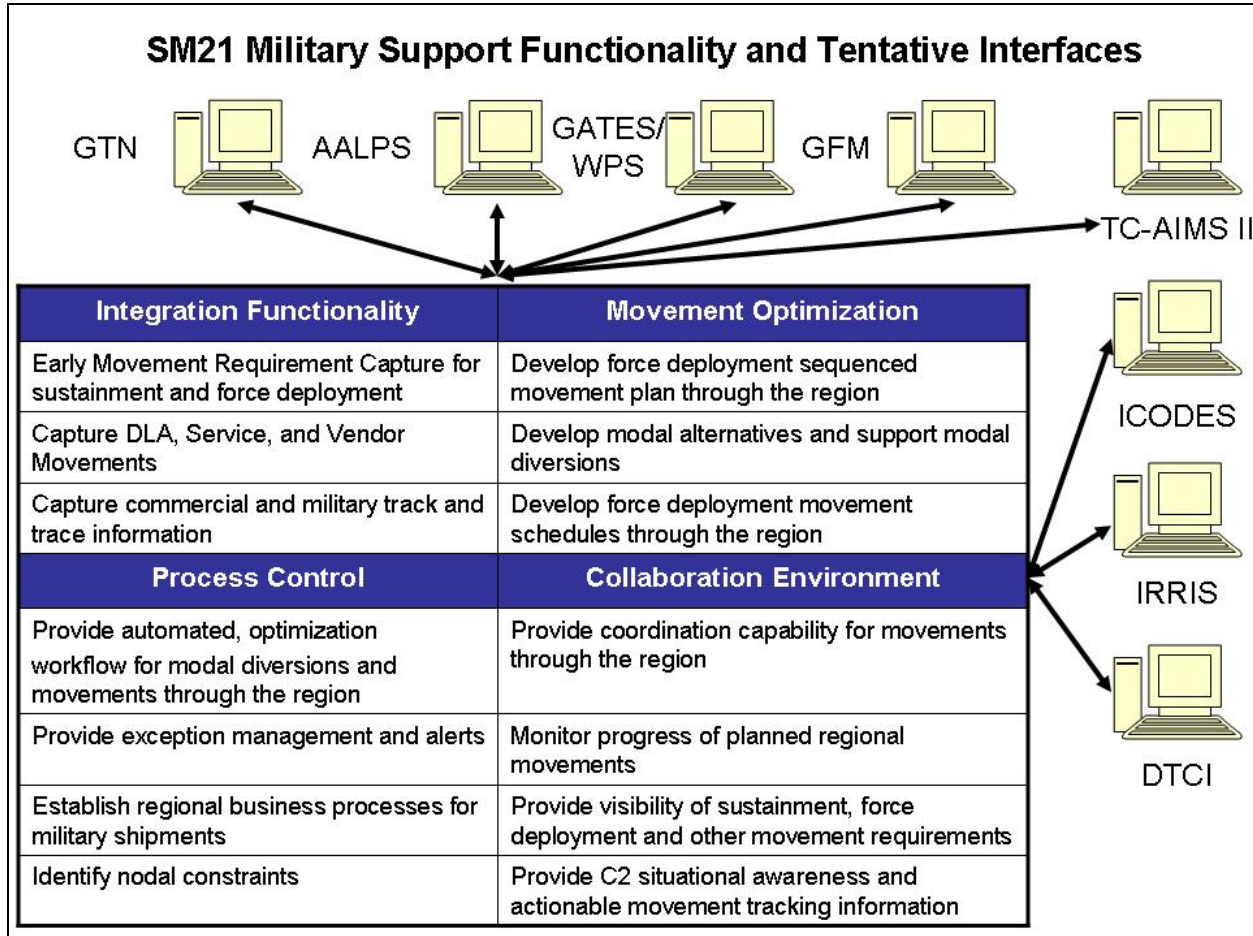


Figure 5: Military System Interface Requirements

The following are the specific military and commercial integration requirements:

- Capability to easily interface bi-directionally with various disparate external systems and consume/ produce various formats.
- Provide connectivity to all partners (military, government and commercial) in the global supply chain (air, ocean, drayage, rail, freight forwarders, customs brokers, third party providers, etc).
- Ability to transmit and receive acknowledgements to/ from the appropriate business partner.
- Access to original transaction data both inbound and outbound transactions.
- Allow on-line re-processing of *Soft Reject* errors.
- Must have the ability to manually resolve missing/ incorrect data.

- Must handle duplicate events in case of multiple sent by sources.
- Ability to monitor all integration electronic data channels and notify operations based upon user-defined thresholds.
- Integrate with yard-based devices that provide audio, video, and data feeds via card and bar code readers, electronic seal, ticket printers, Radio Frequency Identification (RFID) tags, Automatic Equipment Identification (AEI) tags, magnetic card readers, key pads, scale interfaces, Optical Character Recognition (OCR) portals, license plate readers, smart cards and driver ID scanners.
- Ability to integrate with Biometric Security Solutions such as speech recognition, thumb print readers, and other biometrics.
- Ability to integrate with the Integrated Computerized Deployment System (ICODES).
- Ability to integrate with the Transportation Coordinators'- Automated Information for Movements System Version II (TC-AIMS II).
- Ability to integrate with the Automated Air Load Planning System (AALPS).
- Ability to integrate with the Global Freight Management (GFM) System
- Ability to integrate the Global Air Transportation Execution System (GATES) and the Worldwide Port System (WPS).
- Ability to integrate with the Intelligent Road/Rail Information Server (IRRIS).
- Ability to integrate with the future Defense Transportation Coordination Initiative (DTCI)
- Ability to integrate to the U.S. Customs AMS and AES systems.
- Ability to integrate to U.S. Bank's PowerTrack system for billing and payment processing.
- Ability to integrate to Integrated Data Communications Systems (IDCS) for equipment maintenance and repair.
- Ability to integrate to REZ-1 for equipment reservation.
- Ability to integrate with real-time weather reports providers.
- Must provide the ability to produce and consume transportation standard ANSI EDI_x12 transaction sets in traditional flat-file and corresponding XML formats, including but not limited to:

104 Air Shipment Information
160 Transportation AEI
204 Motor Carrier Load Tender
216 Motor Carrier Shipment Pick-Up Notification
301 Ocean Confirmation
309 Customs Manifest
315 Ocean Status
322 Terminal Operations Activity
324 Vessel Stow Plan
404 Rail Shipment Information
417 Rail Waybill Interchange
423 Rail Switch List
810 Invoice
824 Application Advice

110 Air Freight Details
163 Motor Appointment Schedule
214 Motor Carrier Shipment Status
217 Motor Carrier Loading Guide
304 Ocean Shipping Instructions
310 Ocean Freight Receipt
317 Delivery/Pick-Up Order
323 Vessel Schedule
350 Customs Status
410 Rail Freight Details
418 Rail Consist
440 Shipment Weights
820 Payment Order Advice
856 Shipment Notice

858 Shipment Information
944 Warehouse Receipt Advice
996 File Transfer

943 Warehouse Shipment Advice
947 Warehouse Inventory Adjustment
997 Functional Acknowledgement

17.0 TECHNICAL REQUIREMENTS

- System should have a 24/7 staffed Help Desk with appropriate services levels defined.
- System must be available 99.9% (measured by month) which includes scheduled system maintenance windows.
- System must be able to be back on-line to operations within 12 hours after a system disaster has been declared with minimal data loss.
- System should have appropriate service levels defined with the hosting provider.
- System must have pro-active monitoring with automatic notifications sent to the technical support staff warning of any potential system issue.
- Operational customer require access to systems outside of their offices (while on ramps and the yards) to update information as well as receive system updates/ alerts.
- Data retention should include the current year plus two previous years for logistics analysis.
- Provide a customer centric web portal which will provide visibility of shipments.
- System must promote a highly scalable fault tolerant hardware and software architecture.
- Provide authentication and authorization for access to applications and data.
- System must support role-based security and access and promote a uniform enterprise security model.
- Controls access to functions and inventories by user ID (e.g. any customer specific data may be accessed only by customer-authorized users)
- Provides for classes of security so that a user may be assigned to a class, inheriting the security associated with that class.
- Requires each user to have a unique user ID.
- Bars concurrent use of the same user ID.
- Requires each user to have a password and requires passwords to be changed on a scheduled frequency as defined by the system.
- Logs user off system after a defined period of inactivity.
- Suspends user ID after repeated unsuccessful log-on attempts.
- Provides method for tracking user access and system activity.
- Provides method for identifying the user ID and last revision date for each activity.
- Minimize the number of times that a user needs to authenticate themselves to systems.
- All data deemed to be sensitive in nature shall be encrypted.
- Provide secure transport of data while interacting with external systems.
- Support service-oriented solutions; flexible and easily adaptable to business change.
- Separate presentation, business logic and data access layers clearly defined within an application.
- Support a reference architecture that utilizes established design patterns.
- Standardize user interfaces independent of platform.
- Use uniform messaging and data format protocols (i.e. XML)

- Integration of applications to utilize synchronous or asynchronous messaging as appropriate in the solution context and preference will be given to asynchronous communication whenever loose coupling of applications is desired.
- Create shared, common and encapsulated business interfaces.
- Use a content management system to access and manage unstructured data.
- Use a document management system to access and manage various scanned documents.
- Utilize an external business rules engine to provide global and regional rule-based decision support.
- Apply data transformation rules only once within the data architecture.
- Automate end-to-end monitoring of system processes.
- Provide electronic means for data input and data transfer to reduce dependence on paper-based input.

18.0 SUMMARY

The development of IP-MTOPS will be a joint effort between SM21, SCLA, and the City of Victorville. The resulting SOA based software system will support the functions of a dual-use multi-modal inland port. IP-MTOPS will be developed to support the refinement and integration of the functional requirements independently developed by the joint partners. Since the facility is intended for dual-use, SM21 will ensure that DoD stakeholder requirements are integrated to support the JDDE¹⁰.

¹⁰ See footnote 2. The JDDSP is the military component of the dual-use IP-MTOPS.

APPENDIX A: SYSTEM INFORMATION SCENERIOS

The following system information scenarios in which the SCLA Enterprise is expected to participate are provided as reference to this document for procurement actions and should not be considered all-inclusive.

Ocean Import

- The Port and Terminal are pre-noticed of arriving inbound cargo via the vessel manifest. U.S. Customs provides Custom clearance status.

Transaction sets:

- Booking Information, EDI 301;
 - Vessel Manifest, EDI 309;
 - Bill of Lading, EDI 304;
 - Forwarding Instructions, EDI 304;
 - Customs Clearance Status, EDI 350;
 - Vessel Stowage Plan, EDI 324.
- The Port provides status updates as cargo is landed.
Transaction sets:
 - Status Information EDI 304.
 - For efficient handling (ramp, de-ramping) the Port unitizes/containerizes break-bulk cargo to suitable equipment.
 - Automatic matching of arriving equipment and pre-advised information and system suggests terminal yard parking after equipment is identified based on:
 - Non-matching equipment marked for quarantined/ investigation;
 - Customs Hold/Release status;
 - Special Handling considerations (refrigerated, HAZMAT, etc.);
 - Pre-advised forwarding instructions;
 - Foreign Trade Zone (FTZ) Customs status.

Transaction sets:

- Terminal Operations Activity EDI 322.

Ocean Export

- Before the cargo can be accepted the shipment details is arranged between the exporting ocean carrier and shipper.

Transaction sets:

- Booking Information, EDI 301;
 - Bill of Lading, EDI 304;
 - Forwarding Instructions, EDI 304;
 - Customs Clearance Status, EDI 350;
 - Vessel Stowage Plan, EDI 324.
- Based on stowage plans, booking information and local yard situation, the Port plans the train loading sequence and sends that to the Terminal.
 - Terminal system verify load ordering against:
 - Equipment and pre-advised information;
 - Customs hold/release status;
 - Special Handling considerations (refrigerated, HAZMAT, etc.).

- Terminal loads the train according to port ordering.
Transaction sets:
 - Terminal Operations Activity, EDI 322.

Highway Arrival

- The Terminal is receives shipment information from the Consignor.
Transaction sets:
 - Load Tender, EDI 204;
 - Transportation Status, EDI 214.
- Trucker presents himself and delivery documents at the gate.
- Documents are matched against system.
- Trucker is directed to parking area or unloading dock at terminal.
- Equipment/cargo is received.
Transaction sets:
 - Terminal Operations Activity, EDI 322.
- Terminal sends arrival notice to related parties.

Highway Departure

- Terminal receives pickup instructions from the Consignee.
Transaction sets:
 - Load Tender, EDI 204;
 - Response to a Load Tender, EDI 990;
 - Transportation Status, EDI 214.
- Trucker books pickup appointment (Web Interface or EDI).
- Trucker presents himself, delivery documents and pickup reference at the gate.
- Documents are matched against system.
- Equipment/ cargo is released.
Transaction sets:
 - Terminal Operations Activity, EDI 322.
- Terminal sends release notice to related parties.

Inbound Rail

- The Terminal receives Shipment information from the Rail Carrier or Consignor.
Transaction sets:
 - Bill of Lading, EDI 404;
 - Rail Waybill, EDI 417.
- The transport status and progress is reported via status messages.
Transaction sets:
 - Terminal Operations Activity, EDI 322;
 - Car Location Message, NITL CLM.
- Rail Carrier delivers railcars to Terminal.
Transaction sets:
 - Rail Consist, EDI 418.
- Arriving equipment is automatically matched against the pre-advised information.
- System suggests yard parking after equipment is identified based on:

- Non-matching equipment is marked quarantined for investigation;
- Customs hold/release status is recorded against equipment if export;
- Special handling considerations (Refrigerated, HAZMAT, etc.);
- Pre-advised forwarding instructions from Ocean Carrier.

Transaction sets:

- Terminal Operations Activity, EDI 322.
- Terminal sends arrival notice to related parties.

Outbound Rail

- Consignor (Terminal or Freight Agent) issues Shipment to Rail Carrier.

Transaction sets:

- Bill of Lading, EDI 404.
- Rail Carrier accepts shipment and generates a Rail Waybill.

Transaction sets:

- Rail Waybill, EDI 417.
- Terminal plans the train loading and generates work orders.
- Rail Carrier releases empty railcars Terminal.
- Terminal loads railcars.

Transaction sets:

- Terminal Operations Activity, EDI 322.
- Rail Carrier pulls railcars from Terminal.

Transaction sets:

- Rail Consist, EDI 418.

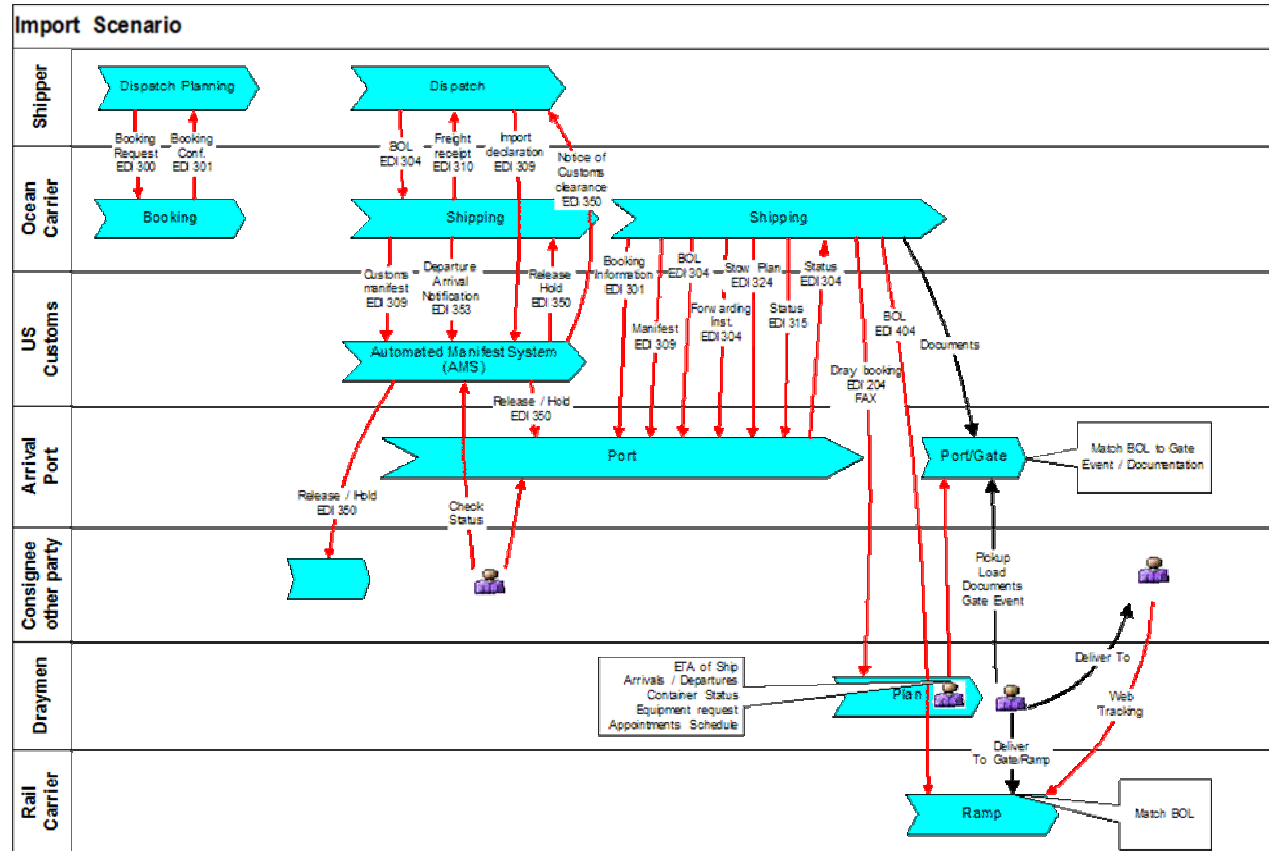


Figure 6: Inbound to Port

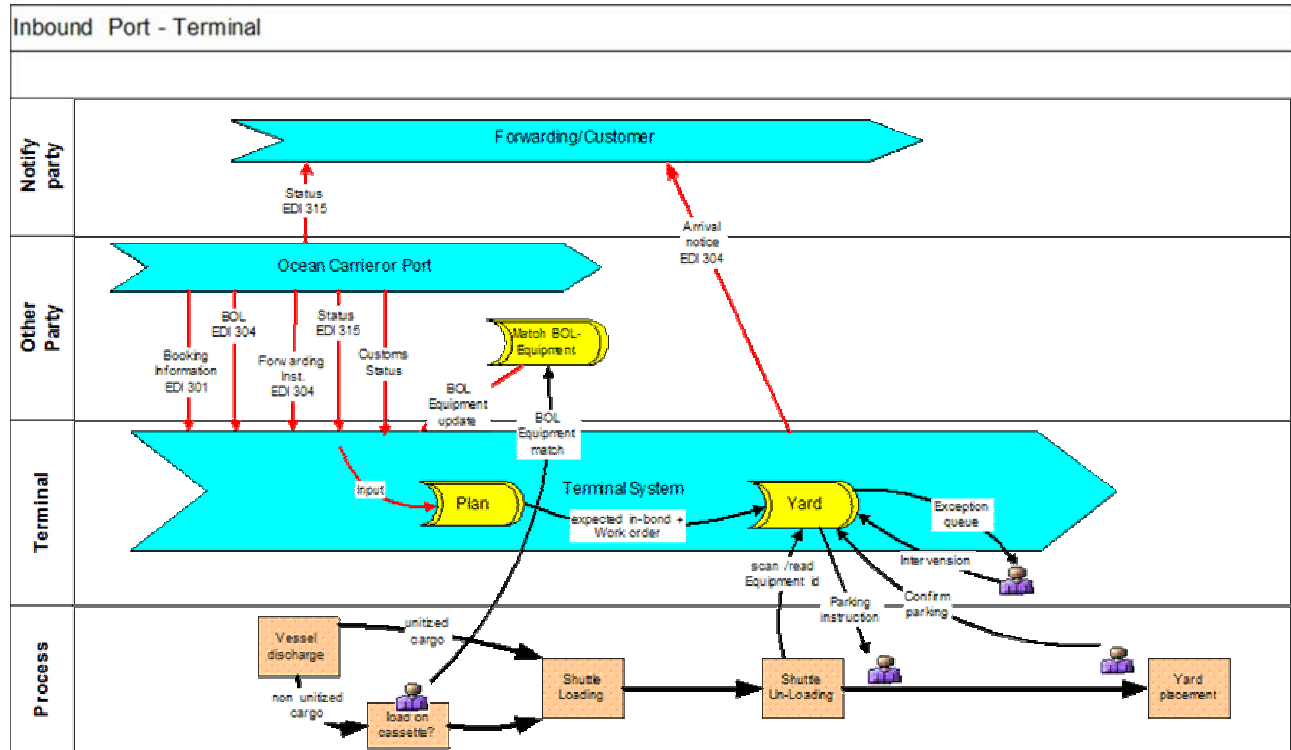


Figure 7: Inbound to Terminal

APPENDIX B: GLOSSARY

Terminology	Definition
AAR	Association of American Railroads. The central coordinating and research agency of the American railway industry. This agency deals with matters of common concern in the whole field of railroading from operations to public relations.
ACCESSORIAL CHARGE	A service in addition to the line haul service, usually at an added expense. Charges incurred to provide additional services at the time of pick-up or delivery of the container. These might include driver assist in load or unload, driver waiting time to load or unload past free-time provision of the tariff, equipment rental (fork lift), blocking or bracing, additional stop-off charges, container charges etc.
ACL	Allowable Cargo Load. The amount of cargo and passengers, determined by weight, cubic displacement, and distance to be flown, that may be transported by specified aircraft.
ALL WATER SERVICE	(AWS) Ocean service from the Far East to the East Coast of the U.S. via the Panama Canal.
BACK HAUL	The movement of freight (or empty equipment) back to the point of origin in a lane of little or no demand for the service.
BAD ORDER	Something is wrong with the equipment.
BENEFICIAL OWNER	The entity that actual has title to the cargo being shipped.
BILL OF LADING	A document that establishes a contract between a shipper and a transportation company that moves freight between specified points for a specified charge. Usually prepared by the shipper on forms issued by the carrier, it serves as a document of title, a contract of carriage and a receipt for the goods.
BLOCKED TRAIN	Railcars grouped in a train by destination so that segments (blocks) can be uncoupled and routed to different destinations as the train moves through various junctions. Eliminates the need to break up a train and sort individual railcars at junctions.
BOC	Beneficial Owner of the Cargo. The entity that actually owns (has title to) the goods. See Beneficial Owner.
BOOKING	Recording arrangements for the movement of goods by ocean or stack train.
BRC	Billing Repair Card. A detailed record of repairs performed in accordance with AAR Rule 83.
BUNDLED RATES	Rates that include all costs in one charge.
CAPACITY PLANNING	A plan which measures and analyzes the ratio of units required versus units available for a given time period. The direct planning of specific units to specific loads.
CARRIER	An individual, company or corporation engaged in transporting goods.
CBP	U.S. Customs and Border Protection of the Department of Homeland Security.
CHASSIS	The wheels and frame assembly that supports the container.
CLAIM	A demand made upon a carrier for payment on account of loss sustained through its negligence or accidental damage while under the carrier's authority.

CLM	Car Location Movement. A railroad record movement of a load.
COFC	Container on flatcar. A container that moves on a flatcar without a chassis.
COMMODITY	The description of the actual goods being shipped.
COMMON CARRIER	A transportation company operating under a Certificate of Convenience and Necessity; provides service to the general public at published rates.
CONSIGNEE	The receiver of the goods being shipped.
CONSIGNOR	A person or company shown on the bill of lading as the shipper.
CONTAINER	A piece of equipment that has a removable chassis. Usually used in ocean carriage or on stack trains. Comes in various sizes: 20', 40', 45', 48' and 53'.
CONTAINER POOL	An agreement between parties that allows the efficient use and supply of containers. A common supply of containers available to the shipper as required.
CONVENTIONAL SERVICE	Containers moving on conventional flatcars (COFC/TOFC) owned by rail carriers.
CROSS-TOWN	A truck movement between one railroad intermodal ramp and another. Utilized either for speed or because the two railroads don't have a connection.
CUBE OUT	When a container has reached its volumetric capacity before it reaches its permitted weight limit.
CUT-OFF TIME	The latest time that a container may be delivered to a rail ramp or vessel in order to be accepted for the scheduled departure time.
CY	Container Yard. A place where chassis and container equipment is stored.
DEMURRAGE	See Per Diem
DERAMPED	A trailer/container that has been taken off a railcar.
DESTINATION	The place where the carrier releases the cargo to the consignee or his agent.
DETENTION	A charge by a vendor after a specific time has passed.
DISPATCH	Information given to the drayman that is picking up a load at origin or delivering it at destination.
DIVERSION	A change made in the route of a shipment in transit
DOOR-TO-DOOR	Through transportation of a container and its contents from consignor to consignee
DOUBLE STACK	Refers to placing one container on top of another container in a double stack railcar for onward movement.
DRAYAGE	The truck portion of an intermodal movement.
DRAYMAN	A carrier who provides pick-up and deliveries via truck to and from the rail yard.
DRIVER ASISST	When the driver is required to load or unload a shipment.
DROP	The driver leaves the trailer at the customer's facility and picks it up after it is loaded or unloaded.
DRY FREIGHT	Dry cargo not requiring temperature control protection
DST	Double Stack Train. Refers to the practice of placing one container on top of another in a special railcar for movement. See double stack.

EARLY WARNING	A directive issued by the AAR for interchange freight cars having mechanical or potential safety problems.
EDI	Electronic Data Interchange; The exchange of information via computer.
EIR	Equipment Interchange Receipt. A form used by parties delivering or receiving containers or container equipment. Used for equipment control and damage liability purposes. Synonymous with TIR (Trailer Interchange Receipt)
EMPTY REPO	Empty repositioning. The movement of empty containers by rail or truck to meet service requirements elsewhere.
EMPTY SLOT	An available loading position on a stack car created when a container isn't loaded to an available position. Also known as a vacant slot.
EN-ROUTE	In transit to destination.
ETA	Estimated Time of Arrival of a load.
FAK	Freight All Kinds; A generic term for any kind of freight.
FCL	Full Container Load
FEU	Forty-foot Equivalent Unit.
FLATCAR	A railcar, which a trailer/container is placed on to move via the railroad. A car without roof or walls.
FLIP	When a container is picked up off of the ground and mounted on a chassis for street or highway transport.
FRA	Federal Railroad Administration. The FRA deals specifically with transportation policy as it affects the nation's railroads and is responsible for enforcement of rail safety laws.
FREE TIME	The amount of time allowed by the carriers for the loading or unloading of freight before charges begin to accrue.
FREIGHT	Refers to either the cargo carried or the charges assessed for the carriage of the cargo.
FREIGHT BILL	A document issued by the carrier based on the bill of lading and other information; used to account for a shipment operationally, statistically, and financially.
FREIGHT FORWARDER	A company that arranges for the movement of import and export shipments. Also prepares all necessary U.S. Customs documentation.
FTZ	Foreign-Trade Zone. A restricted-access site, authorized by the FTZ Board and supervised by CBP (19 CFR 146) where companies can use special Customs procedures prior to entry for consumption. Zones are located in or adjacent to a CBP port of entry and operated pursuant to public utility principles under the sponsorship of a corporation granted authority by the Board pursuant to the Foreign-Trade Zones Act (19 USC 81a-81u) and regulations (15 CFR Part 400).
GATE	A point at an intermodal terminal where a clerk checks in and out all containers and trailer. All reservations and paperwork are checked at the gatehouse.
GENSET	Generator used to regulate temperature in a reefer container; can be run on its own power or plugs provided at the storage area.
GROSS WEIGHT	Combined weight of cargo and container ready for shipment.

HAZMAT	Hazardous Material. Product that is determined to be harmful and requires special handling as set forth by government agencies and the intermodal companies.
HOSTLER	An individual employed to move containers and trailers within a terminal or warehouse yard area.
IANA	Intermodal Association of North America. An industry trade association representing the combined interests of intermodal freight transportation companies.
ICC	Interstate Commerce Commission. A federal regulatory agency that governed over the rules and regulations of the railroading industry. The ICC Termination Act of 1995 ended this regulatory agency. Most responsibilities were transferred to the Surface Transportation Board.
IMC	Intermodal Marketing Company. An intermediary in the movement of intermodal shipments. See Third Party.
IN-BOND	A shipment that is moving but has not cleared U.S. Customs. The clearing of U.S. Customs will occur at destination.
INBOUND	Cargo moving from a rail terminal towards its destination. Generally used for cargo coming off a train and heading for final delivery to consignee.
IN-GATE	The transaction or interchange that occurs at the time a container is received by a rail terminal, container yard, or water terminal from another carrier.
INTERCHANGE	The exchange of railcars between connecting railroads.
INTERLINE	Between two or more transportation companies.
IPI	Inland Point Intermodal. A shipment booked and moved from foreign origin port to U.S. inland destination for one quoted charge by the steamship line.
ISO	International Organization for Standardization
J-1	A report filled out during the in-gate and out-gate process. The J-1 details damage to the unit, container information, shipping information, drayman involved and time of in-gate/ out-gate.
JOB CODE	A 4 digit number that identifies the inspection, repair, and/ or testing performed, or the car component applied or removed.
LADING	Refers to the freight shipped; the contents of a shipment.
LIFT	The process of moving a container or trailer to and or from a rail car.
LINE HAUL	The movement of freight via railroad from one city to another.
LIVE LOAD	The driver stays with a load while it is being loaded or unloaded.
LOCAL CARGO	Cargo that is booked from a foreign port to a U.S. port with no inland movement of the freight by the steamship line.
LTL	Less Than Truckload. A shipment that would not by itself fill the truck to capacity by weight or volume.
M&R	Maintenance and Repair. The process of maintaining equipment in good repair and serviceability.
MARINE TERMINAL	The facility where cargo is discharged from and loaded to the ocean vessel.
MHE	Materials-Handling Equipment. Mechanical devices for handling cargo.

NET WEIGHT	Weight of the cargo alone, without any immediate wrappings.
NOTIFY PARTY	The party that is notified at the time a container or trailer is grounded from a train. Most notify parties are draymen.
NVOCC	Non Vessel Operating Common Carrier. A company that buys wholesale space on steamship lines and resells the space to individual shippers at a profit.
OCP CARGO	Overland Common Point. Refers to cargo that is handled by the steamship line only to a U.S. port of entry. The shipper or consignee then plans to move the cargo inland (east of the Rockies) at their expense.
OD PAIR	Origin / destination locations identified in a tariff rate structure.
ON-DOCK	Refers to the process whereby cargo from the ocean vessel is loaded to railcars within the marine terminal.
ORIGIN	Location where shipment begins its movement at cargos expense.
OUTBOUND	Cargo moving from a shipper to rail ramp. Generally refers to cargo going onto a stack or conventional train.
OUT-GATE	The transaction or interchange that occurs at the time a container is delivered from a rail terminal, CY, or water terminal to another carrier.
OVER-THE-ROAD (OTR)	An all truck freight shipment, used in lieu of rail service, at a premium charge.
OWNER CODE (SCAC)	Standard Carrier Abbreviation Code identifying the carrier – drayman, steamship line etc.
PALLET	A wooden, paper or plastic platform usually with a top and bottom, on which packaged goods are placed to facilitate movement by some type of freight handling equipment.
PER DIEM	Additional charges to the shipper or consignee for a carrier's equipment past the free time provisions of the equipment interchange contract while the equipment remains in the possession of the shipper or consignee.
PICK-UP	The act of calling for freight by truck at the consignors shipping platform.
PICK-UP APPOINTMENT	Scheduled time for pick-up or loading of a container from a shipper or consignee.
PICK-UP NUMBER	A secure number provided to parties listed on the waybill. It allows only those parties to receive a container in order to out-gate from ramp facilities.
POD	Proof of Delivery. A form signed by the consignee, proving the load has been delivered.
POOL	A group of equipment at a customer's facility for them to load at their convenience.
PRENOTE	Information sent to the delivering carrier, telling where, when and how to deliver a load.
RAIL GROUNDING	The time that the container was discharged (grounded) from the train.
RAIL NOTIFICATION	Notification to the <i>Notify Party</i> that the container has been discharged from the train and is available for pick-up.
RAIL RAMP	The location where the draymen pick up and deliver loads to the railroad, and where trains are loaded or discharged.

RAMP	A technical rail ramp not serviced by an actual train.
RAMPED	A trailer/container that has been placed on a railcar.
REVENUE LOAD	A load of freight for which freight charges are applied.
REVENUE WAYBILL	A waybill showing the amount of charges due on a shipment.
RULE 11	A railroad accounting term which refers to a customer shipping their freight "pre-paid" to an intermediate point and "collect" beyond that intermediate point to the final destination.
SCAC	See Owner Code.
SEAL	Something applied to the outside of equipment doors after loading to assure the load has not been tampered with.
SERVICE FAILURE	When the actual delivery exceeds the customer's expectations by a specific amount of time.
SHIPMENT	The tender of one lot of cargo at one time from one shipper at one location to one consignee at one destination, on one bill of lading.
SHIPPER	The actual party tendering a load of freight.
SHIPPING ORDER	Instructions of shipper to a carrier for forwarding of goods.
SHORING	A system of horizontal and/or inclined structural members fastened to the piles of a bent, group or row to increase stability by resisting or distributing lateral forces to the structure. Similar to bracing.
SLOT UTILIZATION	The method of utilizing every space available on a double stack car. A slot includes the space above a container when another container can be double-stacked. A five platform double stack car has 10 slots available for loading. If all 10 slots are loaded, you have 100% slot utilization.
SPOTTING	Placing a container where required to be loaded or unloaded
STACK CAR	An articulated five or three-platform railcar that allows containers to be double stacked.
STACK TRAIN	A dedicated train that hauls containers stacked two high.
STAY WITH	Type of drayman service whereby the driver remains with the freight while the shipper or consignee loads or unloads.
STCC	"Standard Transportation Commodity Code. A method of identifying products or commodities using standardized numeric codes.
STORAGE CHARGES	See Demurrage/ Per Diem.
SURCHARGE	An extra or additional charge.
TARE WEIGHT	The weight of packing material, or in railcar or container shipments, the weight of the empty railcar or empty container.
TARIFF	A publication setting forth the charges, rates and rules for transportation companies.
TENDER	The offer of goods for transportation or the offer to place cars or containers for loading or unloading.
TERMINAL	An assigned area in which containers are prepared for loading onto a train or are stored after discharge from a train.

TERMINAL CHARGE	A charge made for services performed in a carrier's terminal area.
TEU	Twenty-foot Equivalent Unit. A standard container size used for comparative measuring purposes. Normally applied to containers used by steamship lines (20, 40 and 45 foot containers)
THIRD PARTY	Refers to an intermediary, which arranges for the movement of intermodal shipments.
THIRD PARTY INTERNATIONAL	An ocean shipping company
TOFC	Trailer On Flat Car. A trailer that moves on a flat car with the chassis attached.
TRAILER	A freight vehicle equipped with a permanent wheel assembly and a device for attaching to a tractor for movement.
TRAILER INTERCHANGE	Transfer of a trailer and lading from one carrier to another.
TRAIN ID	A system to identify the trains origin and destination points, the day of the week for departure and the week of the year it moved.
TRANS PACIFIC	Import/export water service to and from the West Coast ports to and from Far East ports.
TRANSIT TIME	The actual amount of time for a load to move from point of origin to delivery at destination.
TRANSLOAD	The transferring of product from one piece of equipment to another.
UMLER	Universal Machine Language Equipment Register. A computer readable file of vital statistics for each railroad car in service. It applies to all railroads, types of cars, and data processing machines.
UNBUNDLED	A product that will have separate charges for each activity accorded to the shipment
UNIT TRAIN	A train of a specified number of railcars, which remain as a unit for a designated destination or until a change in routing is made.
WASTE CUBE	A container with empty space. May result when the weight load is reached before the volumetric limit.
WAYBILL	A document prepared by a transportation line at the point of a shipment; shows the point of origin, destination, route, consignor, consignee, description of shipment and amount charged for the transportation service. A waybill is forwarded with the shipment or sent by mail to the agent at the transfer point or waybill destination. Unlike a bill of lading, a waybill is not a document of title.
WHY MADE CODE	Numeric code used to designate the reason repairs or services were made or performed.
YARD	A classification, storage or switching area.

APPENDIX C: REFERENCES

1. Advent Inc, *Advent Terminal Operating System (TOS)*, www.adventinc.com
2. Canadian National, *Intermodal Terminal Management System (ITMS)*, www.cn.ca
3. Cargo Data Management Corp, *Station Track II*, www.cargodata.com
4. Central Systems & Automation Ltd, *Autostore Container Terminal Management System (CTMS)*, www.central-systems.co.uk
5. CMC Limited, *Marine Container Handling System*, www.cmcltd.com
6. COSMOS, *COSMOS Terminal Systems*, www.cosmos.be
7. CSX, *Intermodal Terminal Operations System (ITOPS)*, www.csxi.com
8. Embarcadero Systems Corporation, *Computer Automated Terminal Operation System (CATOS); Premier Appointment System (PAS)*, www.esystem.com
9. eOPS Inc, *eTERM*, www.etermsys.com
10. Erl, Thomas. *Service-Oriented Architecture: Concepts, Technology, and Design*, Upper Saddle River, NJ: Prentice Hall Professional Technical Reference, 2005
11. Hamburg Port Consulting, *Container Terminal Information System (CTIS)*, www.hamburgportconsulting.de
12. IBS Software Services, *iLogistics*, www.ibsplc.com
13. IntelliTrans LLC, *Global Visibility Platform (GVP); Material Management System (M2S)*, www.intellitrans.com
14. Kale Consultants Ltd, *MERCURY*, www.kaleconsultants.com
15. Maher Terminals Logistic Systems, *MTLS Container Terminal Management System*, www.mtls.co
16. Mercator, *Chameleon*, www.mercator.com
17. Navis, *SPARCS Terminal Operating System*, www.navis.com
18. Optimization Alternatives, *Optimization Alternatives' Strategic Intermodal Scheduler (OASIS); Yard Hawk*, www.oax.com
19. Sabre Airline Solutions, *CargoMax*, www.sabreairlinesolutions.com
20. Softship, *Terminal Management System (TMS)*, www.softship.com
21. Virtual Yard Management Inc., *KT3 Yard Management System (YMS)*, www.vyminc.com